Models
83
85
87

SE LABORATORIES
MANUAL

FLUKE
80 Series
Multimeters

Service Manual

FLUKE

FLUKE
80 Series
Multimeters

Service Manual

P/N 834168
April 1989
Rev. 1, 8/89
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FLUKE 80 SERIES

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Frontispiece

Section 1
Introduction and Specifications

1-1. INTRODUCTION

This manual covers servicing information for Fluke multimeter Models 83, 85, and 87. This service manual will prove useful for tasks ranging from routine maintenance to troubleshooting and repair. Specifications, theory of operation, calibration routines, testing and troubleshooting procedures, parts replacement information, and schematic diagrams are provided.

A meter under warranty will be promptly repaired or replaced (at Fluke's option) and returned at no charge. See the registration card for warranty terms. If the warranty has lapsed, the meter will be repaired and returned for a fixed fee. Contact the nearest Service Center for information and prices. A list of U.S. and International Service Centers is included at the end of Section 4 of this manual.

1-2. ORGANIZATION OF THE SERVICE MANUAL

The following descriptions for the various sections serve to introduce the manual.

SECTION 1. INTRODUCTION AND SPECIFICATIONS

This section describes both use of the Service Manual and application of special terminology (conventions) to describe the meter's circuitry. A complete set of specifications appears at the end of this section.

SECTION 2. THEORY OF OPERATION

This section first categorizes instrument circuitry into functional blocks, with a description of each block's role in overall operation. A detailed circuit description is then given for each block. These descriptions explore operation to the component level and fully support troubleshooting and repair procedures defined in Section 3.

SECTION 3. MAINTENANCE

Provides complete maintenance information, from general maintenance and cleaning instructions to detailed troubleshooting and repair procedures to the component level. Troubleshooting and repair procedures rely closely on both the Theory of Operation presented in Section 2 and the Schematic Diagrams shown in Section 5.

SECTION 4. LIST OF REPLACEABLE PARTS

Includes parts lists for all standard assemblies. Information on how and where to order parts is also provided.

SECTION 5. SCHEMATIC DIAGRAMS

Includes schematic diagrams for all assemblies. A list of mnemonic definitions is also included to aid in identifying signal name abbreviations.

1-3. CONVENTIONS

Throughout the manual, certain notational conventions are used. A summary of these conventions follows:

- Instrument Reference

  When the discussion involves common features of the Fluke 80 Series multimeters, the term multimeter is used, and the model number is not used. Where features differ among models, further identification is made by model number (Model 83, 85, or 87).

- Printed Circuit Assembly

  The term pca is used to represent a printed circuit board and its attached parts.

- Signal Logic Polarity

  Signal names followed by a - are active (or asserted) low. Signals not so marked are active high.

- Circuit Nodes

  Individual pins or connections on a component are specified with a dash (-) following the component reference designator. For example, pin 19 of U30 would be U30-19.

- User Notation

  Generally, buttons to be pressed, function positions to select, input terminals to use, and display notation to be read are presented in this manual as they are seen on the multimeter. However, one button on the Model 83/85 and two buttons on the Model 87 use no terminology and are identified by color (blue or yellow) in this manual.

  Special terms (mnemonics) used in text descriptions of multimeter circuitry correspond to terms used on the schematic diagrams in Section 5.

1-4. SPECIFICATIONS

Specifications for Models 83 and 85 are presented in Table 1-1. Model 87 specifications are presented in Table 2-2.

Table 1-1. Specifications, Models 83 and 85

FUNCTION	RANGE	RESOLUTION	ACCURACY[1]		
~V (Fluke 83)			50 Hz - 60 Hz	45 Hz - 5 kHz	
	400.0 mV	0.1 mV	±(1.0% + 4)	±(1.5% + 4)	
	4.000V	0.001V	±(1.0% + 3)	±(1.5% + 3)	
	40.00V	0.01V	±(1.0% + 3)	±(1.5% + 3)	
	400.0V	0.1V	±(1.0% + 3)	±(1.5% + 3)	
	1000V	1V	±(1.0% + 3)	±(2.5% + 3)	
~V (Fluke 85)			50 Hz-60 Hz	45 Hz-5 kHz	5 kHz-20 kHz
	400.0 mV	0.1 mV	±(0.5% + 4)	±(1.0% + 4)	±(2.0% + 4)
	4.000V	0.001V	±(0.5% + 2)	±(1.0% + 2)	±(4.0% + 4)
	40.00V	0.01V	±(0.5% + 2)	±(1.0% + 2)	±(4.0% + 4)
	400.0V	0.1V	±(0.5% + 2)	±(1.0% + 2)	±(4.0% + 4)
	1000V	1V	±(0.5% + 2)	±(2.0% + 2)	Unspecified
			Fluke 83	**Fluke 85**	
⎓V	4.000V	0.001V	±(0.3% + 1)	±(0.1% + 1)	
	40.00V	0.01V	±(0.3% + 1)	±(0.1% + 1)	
	400.0V	0.1V	±(0.3% + 1)	±(0.1% + 1)	
	1000V	1V	±(0.3% + 1)	±(0.1% + 1)	
⎓mV	400.0 mV	0.1 mV	±(0.3% + 1)	±(0.1% + 1)	
Ω	400.0Ω	0.1Ω	±(0.4% + 1)	±(0.2% + 1)	
	4.000 kΩ	0.001 kΩ	±(0.4% + 1)	±(0.2% + 1)	
	40.00 kΩ	0.01 kΩ	±(0.4% + 1)	±(0.2% + 1)	
	400.0 kΩ	0.1 kΩ	±(0.4% + 1)	±(0.2% + 1)	
	4.000 MΩ	0.001 MΩ	±(0.4% + 1)	±(0.2% + 1)	
	40.00 MΩ	0.01 MΩ	±(1% + 3)	±(1% + 3)	
(nS)	40.00 nS	0.01 nS	±(1% + 10)	±(1% + 10)	

1 Accuracy is given as ±([% of reading] + [number of least significant digits]) at 18° C to 28° C with relative humidity up to 90%, for a period of one year after calibration. AC conversions are ac-coupled, average responding, and calibrated to the rms value of a sine wave input.

Table 1-1. Specifications, Models 83 and 85 (cont)

FUNCTION	RANGE	RESOLUTION	ACCURACY[2]
Capacitance	5.00 nF	0.01 nF	±(1% +35)[3]
	0.0500 μF	0.0001 μF	±(1% + 2)
	0.500 μF	0.001 μF	±(1% + 2)
	5.00 μF	0.01 μF	±(1% + 2)
Diode Test	3.000V	0.001V	±(2% + 1)

FUNCTION	RANGE	RESOLUTION	ACCURACY		BURDEN VOLTAGE
			Fluke 83	Fluke 85	TYPICAL
mA A ~ (45 Hz to 2 kHz)	40.00 mA	0.01 mA	±(1.2% + 2)	±(0.6% + 2)	1.6 mV/mA
	400.0 mA	0.1 mA	±(1.2% + 2)	±(0.6% + 2)	1.6 mV/mA
	4000 mA	1 mA	±(1.2% + 2)	±(0.6% + 2)	0.03 V/A
	10.00A[4]	0.01A	±(1.2% + 2)	±(0.6% + 2)	0.03 V/A
mA A ⎓	40.00 mA	0.01 mA	±(0.4% + 2)	±(0.2% + 2)	1.6 mV/mA
	400.0 mA	0.1 mA	±(0.4% + 2)	±(0.2% + 2)	1.6 mV/mA
	4000 mA	1 mA	±(0.4% + 2)	±(0.2% + 2)	0.03 V/A
	10.00A[4]	0.01A	±(0.4% + 2)	±(0.2% + 2)	0.03 V/A
μA ~ (45 Hz to 2 kHz)	400.0 μA	0.1 μA	±(1.2% + 2)	±(0.6% + 2)	100 μV/μA
	4000 μA	1 μA	±(1.2% + 2)	±(0.6% + 2)	100 μV/μA
μA ⎓	400.0 μA	0.1 μA	±(0.4% + 2)	±(0.2% + 2)	100 μV/μA
	4000 μA	1 μA	±(0.4% + 2)	±(0.2% + 2)	100 μV/μA

FUNCTION	RANGE	RESOLUTION	ACCURACY
Frequency (0.5 Hz to 200 kHz, pulse width >2 μs)	199.99	0.01 Hz	±(0.005% + 1)
	1999.9	0.1 Hz	±(0.005% + 1)
	19.999 kHz	0.001 kHz	±(0.005% + 1)
	199.99 kHz	0.01 kHz	±(0.005% + 1)
	>200 kHz	0.1 kHz	Unspecified

2 With film capacitor or better

3 ±(1% + 2) if Relative mode is used to zero residual

4 10A continuous, 20A for 30 seconds maximum

Table 1-1. Specifications, Models 83 and 85 (cont)

FREQUENCY COUNTER SENSITIVITY AND TRIGGER LEVEL			
INPUT RANGE	**MINIMUM SENSITIVITY (RMS SINEWAVE)**		**APPROXIMATE TRIGGER LEVEL (DC VOLTAGE FUNCTION)**
(Maximum input for specified accuracy = 10X Range or 1000V)	**5 Hz-20 kHz**	**0.5 Hz-200 kHz**	
400 mV dc	70 mV (to 400 Hz)	70 mV (to 400 Hz)	40 mV
400 mV ac	150 mV	150 mV	—
4V	0.3V	0.7V	1.7V
40V	3V	7V	4V
400V	30V	70V (≤140 kHz)	40V
1000V	300V	700V (≤14 kHz)	400V
Duty Cycle	0.1 to 99.9%	(0.5 Hz to 200 kHz, pulse width >2 μs)	
	Accuracy:	Within ±(0.05% per kHz + 0.1%) of full scale for a 5V logic family input on the 4V dc range.	
		Within ± ((0.06 x Voltage Range / Input Voltage) X 100%) of full scale for sine wave inputs on ac voltage ranges.	

FUNCTION	OVERLOAD PROTECTION[5]	INPUT IMPEDANCE (nominal)	COMMON MODE REJECTION RATIO (1 kΩ unbalance)	NORMAL MODE REJECTION RATIO
$\overline{\overline{V}}$	1000V rms	10 MΩ<100 pF	>120 dB at dc, 50 Hz or 60 Hz	>60 dB at 50 Hz or 60 Hz
$\overline{\overline{mV}}$	1000V rms	10 MΩ<100 pF	>120 dB at dc, 50 Hz or 60 Hz	>60 dB at 50 Hz or 60 Hz
$\widetilde{V}$	1000V rms	10 MΩ<100 pF (ac-coupled)	>60 dB, dc to 60 Hz	

Ω		OPEN CIRCUIT TEST VOLTAGE	FULL SCALE VOLTAGE		SHORT CIRCUIT CURRENT
			To 4.0 MΩ	40 MΩ or nS	
	1000V rms[6]	<1.3V dc	<450 mV dc	<1.3V dc	<500 μA
Diode Test	1000V rms[6]	<3.9V dc	3.000V dc		1.0 mA typical

5 10^7 V Hz max

6 For circuits < 0.3A short circuit, 660V for high energy circuits.

Table 1-1. Specifications, Models 83 and 85 (cont)

	NOMINAL RESPONSE	ACCURACY (5% to 100% of range)
MIN MAX Recording	100 ms to 80%	specified accuracy ±12 digits for changes >200 ms in duration (±40 digits in AC with beeper on)
	1 s	same as specified accuracy for changes >2 seconds in duration (±40 digits in AC with beeper on)

FUSE PROTECTION	
mA or μA	1A 600V FAST Fuse
A	15A 600V FAST Fuse

MAXIMUM VOLTAGE BETWEEN ANY TERMINAL AND EARTH GROUND
1000 Volts

Display	Digital: 4000 counts, updates 4/sec Analog: 43 segments, updates 40/sec Frequency: 19,999 counts, updates 3/sec @ > 10 Hz
Operating Temperature	-20°C to 55°C
Storage Temperature	-40°C to 60°C
Temperature Coefficient	0.05 x (specified accuracy)/°C (<18°C or >28°C)
Relative Humidity	0% to 90% (0°C to 35°C) 0% to 70% (35°C to 55°C)
Battery Type	9V, NEDA 1604 or 6F22 or 006P
Battery Life	500 hrs typical with alkaline
Shock, Vibration	Per MIL-T-28800 for a Class 2 Instrument
Size (HxWxL)	1.25 in x 3.41 in x 7.35 in (3.1 cm x 8.6 cm x 18.6 cm)
With Holster and Flex-Stand:	2.06 in x 3.86 in x 7.93 in (5.2 cm x 9.8 cm x 20.1 cm)
Weight	12.5 oz (355g)
With Holster and Flex-Stand:	22.0 oz (624g)
Safety	Designed to Protection Class II per IEC 348, ISA-DS82, and UL1244

Table 1-2. Specifications, Model 87

FUNCTION	RANGE	RESOLUTION	ACCURACY[1]		
			50 Hz-60 Hz	45 Hz-5 kHz	5 kHz-20 kHz[2]
~V	400.0 mV	0.1 mV	±(0.7% + 4)	±(1.0% + 4)	±(2.0% + 4)
	4.000V	0.001V	±(0.7% + 2)	±(1.0% + 4)	±(2.0% + 4)
	40.00V	0.01V	±(0.7% + 2)	±(1.0% + 4)	±(2.0% + 4)
	400.0V	0.1V	±(0.7% + 2)	±(1.0% + 4)	±(2.0% + 4)
	1000V	1V	±(0.7% + 2)	±(1.0% + 4)[2]	Unspecified
⎓V	4.000V	0.001V	±(0.1% + 1)		
	40.00V	0.01V	±(0.1% + 1)		
	400.0V	0.1V	±(0.1% + 1)		
	1000V	1V	±(0.1% + 1)		
⎓mV	400.0 mV	0.1 mV	±(0.1% + 1)		
Ω	400.0Ω	0.1Ω	±(0.2% + 1)		
	4.000 kΩ	0.001 kΩ	±(0.2% + 1)		
	40.00 kΩ	0.01 kΩ	±(0.2% + 1)		
	400.0 kΩ	0.1 kΩ	±(0.2% + 1)		
	4.000 MΩ	0.001 MΩ	±(0.2% + 1)		
	40.00 MΩ	0.01 MΩ	±(1% + 3)		
(nS)	40.00 nS	0.01 nS	±(1% + 10)		

FUNCTION	RANGE	RESOLUTION	ACCURACY[3]
Capacitance	5.00 nF	0.01 nF	±(1% + 35)[4]
	0.0500 μF	0.0001 μF	±(1% + 2)
	0.500 μF	0.001 μF	±(1% + 2)
	5.00 μF	0.01 μF	±(1% + 2)
Diode Test	3.000V	0.001V	±(2% + 1)

FUNCTION	RANGE	RESOLUTION	ACCURACY	BURDEN VOLTAGE TYPICAL
mA A ~	40.00 mA	0.01 mA	±(1.0% + 2)	1.6 mV/mA
(45 Hz to 2 kHz)	400.0 mA	0.1 mA	±(1.0% + 2)	1.6 mV/mA
	4000 mA	1 mA	±(1.0% + 2)	0.03 V/A
	10.00A[5]	0.01A	±(1.0% + 2)	0.03 V/A
mA A ⎓	40.00 mA	0.01 mA	±(0.2% + 2)	1.6 mV/mA
	400.0 mA	0.1 mA	±(0.2% + 2)	1.6 mV/mA
	4000 mA	1 mA	±(0.2% + 2)	0.03 V/A
	10.00A[5]	0.01A	±(0.2% + 2)	0.03 V/A

1 Accuracy is given as ±([% of reading] + [number of least significant digits]) at 18° C to 28° C, with relative humidity up to 90%, for a period of one year after calibration. In the 4½-digit mode, multiply the number of least significant digits (counts) by 10. AC conversions are ac-coupled, true rms responding, calibrated to the rms value of a sine wave input, and valid from 5% to 100% of range. AC crest factor can be up to 3 at full scale, 6 at half scale.

2 Below 10% of range, add 16 counts.

3 With film capacitor or better

4 ±(1% + 2) if Relative mode is used to zero residual

5 10A continuous, 20A for 30 seconds maximum

Table 1-2. Specifications, Model 87 (cont)

FUNCTION	RANGE	RESOLUTION	ACCURACY	BURDEN VOLTAGE TYPICAL
$\widetilde{\mu A}$ (45 Hz to 2 kHz)	400.0 μA	0.1 μA	±(1.0% + 2)	100 μV/μA
	4000 μA	1 μA	±(1.0% + 2)	100 μV/μA
$\overline{\widetilde{\mu A}}$	400.0 μA	0.1 μA	±(0.2% + 2)	100 μV/μA
	4000 μA	1 μA	±(0.2% + 2)	100 μV/μA

FUNCTION	RANGE	RESOLUTION	ACCURACY
Frequency (0.5 Hz to 200 kHz, pulse width >2 μs)	199.99	0.01 Hz	±(0.005% + 1)
	1999.9	0.1 Hz	±(0.005% + 1)
	19.999 kHz	0.001 kHz	±(0.005% + 1)
	199.99 kHz	0.01 kHz	±(0.005% + 1)
	>200 kHz	0.1 kHz	Unspecified

FREQUENCY COUNTER SENSITIVITY AND TRIGGER LEVEL

INPUT RANGE (Maximum input for specified accuracy = 10X Range or 1000V)	MINIMUM SENSITIVITY (RMS SINEWAVE) 5 Hz-20 kHz	MINIMUM SENSITIVITY (RMS SINEWAVE) 0.5 Hz-200 kHz	APPROXIMATE TRIGGER LEVEL (DC VOLTAGE FUNCTION)
400 mV dc	70 mV (to 400 Hz)	70 mV (to 400 Hz)	40 mV
400 mV ac	150 mV	150 mV	—
4V	0.3V	0.7V	1.7V
40V	3V	7V	4V
400V	30V	70V (≤140 kHz)	40V
1000V	300V	700V (≤14 kHz)	400V

Duty Cycle 0.0 to 99.9% (0.5 Hz to 200 kHz, pulse width >2 μs)

Accuracy: Within ±(0.05% per kHz + 0.1%) of full scale for a 5V logic family input on the 4V dc range.

Within ±((0.06 x Voltage Range/Input Voltage) x 100%) of full scale for sine wave inputs on ac voltage ranges.

Table 1-2. Specifications, Model 87 (cont)

FUNCTION	OVERLOAD PROTECTION[6]	INPUT IMPEDANCE (nominal)	COMMON MODE REJECTION RATIO (1 kΩ unbalance)	NORMAL MODE REJECTION
$\overline{\overline{V}}$	1000V rms	10 MΩ<100 pF	>120 dB at dc, 50 Hz or 60 Hz	>60 dB at 50 Hz or 60 Hz
$\overline{\overline{mV}}$	1000V rms	10 MΩ<100 pF	>120 dB at dc, 50 Hz or 60 Hz	>60 dB at 50 Hz or 60 Hz
$\widetilde{V}$	1000V rms	10 MΩ<100 pF (ac-coupled)	>60 dB, dc to 60 Hz	

		OPEN CIRCUIT TEST VOLTAGE	FULL SCALE VOLTAGE		SHORT CIRCUIT CURRENT
			To 4.0 MΩ	40 MΩ or nS	
Ω	1000V rms[7]	<1.3V dc	<450 mV dc	<1.3V dc	<500 μA
Diode Test	1000V rms[7]	<3.9V dc	3.000V dc		1.0 mA typical

	NOMINAL RESPONSE	ACCURACY
MIN MAX Recording	100 ms to 80%	Specified accuracy ±12 digits for changes >200 ms in duration (±40 digits in AC)
	1 s	Same as specified accuracy for changes >2 seconds in duration
	1ms	Specified accuracy +/- 40 digits for changes >1 ms in duration. (+/- 100 digits typical for mV, 400 μA dc, 40 mA dc, 4000 mA dc).

FUSE PROTECTION	
mA or μA	1A 600V FAST Fuse
A	15A 600V FAST Fuse

MAXIMUM VOLTAGE BETWEEN ANY TERMINAL AND EARTH GROUND
1000 Volts

6 10^7 V Hz max

7 For circuits < 0.3A short circuit, 660V for high energy circuits.

Table 1-2. Specifications, Model 87 (cont)

Display	Digital: 4000 counts, updates 4/sec 19,999 counts (4 ½-digit mode), updates 1/sec Analog: 4 x 32 segments (equivalent to 128), updates 40/sec Frequency: 19,999 counts, updates 3/sec @ > 10 Hz Backlight: On for 68 seconds when selected.
Operating Temperature	-20°C to 55°C
Storage Temperature	-40°C to 60°C
Temperature Coefficient	0.05 x (specified accuracy)/°C (<18°C or >28°C)
Relative Humidity	0% to 90% (0°C to 35°C) 0% to 70% (35°C to 55°C)
Battery Type	9V, NEDA 1604 or 6F22 or 006P
Battery Life	400 hrs typical with alkaline
Shock, Vibration	Per MIL-T-28800 for a Class 2 Instrument
Size (HxWxL)	1.25 in x 3.41 in x 7.35 in (3.1 cm x 8.6 cm x 18.6 cm)
With Holster and Flex-Stand:	2.06 in x 3.86 in x 7.93 in (5.2 cm x 9.8 cm x 20.1 cm)
Weight	12.5 oz (355g)
With Holster and Flex-Stand:	22.0 oz (624g)
Safety	Designed to Protection Class II per IEC 348, ISA-DS82, and UL1244

Section 2
Theory of Operation

2-1. INTRODUCTION

This section describes the theory of operation for the Fluke 83, Fluke 85, and Fluke 87. Unless otherwise specified, the descriptions apply to all three instruments.

Functional block descriptions present an initial overview of circuit operation. Detailed circuit descriptions then cover the major circuit functions in more detail. For reference, detailed schematic diagrams are included in Section 5.

2-2. FUNCTIONAL BLOCK DESCRIPTION

Refer to Figure 2-1 for a block diagram of the Fluke 80 Series Multimeters. The instrument is partitioned into analog and digital sections. The integrated multimeter chip (U4) performs both analog and digital functions. Also, note that the Fluke 87 incorporates additional analog circuits.

The analog section of U4 contains the a/d converter, active filter, ac converter (for Models 83 and 85), frequency comparator, analog signal routing, range switching, and power supply functions.

The digital logic portion of U4 provides the state machine for synchronous a/d converter control and the 16-bit counter used for a/d converter counts and frequency measurements. Also, the digital logic section contains bus and interrupt control circuits (to facilitate the microcomputer interface) and registers for analog switch drive.

The microcomputer section of U4 executes software functions, formats data for the display, drives the display, and controls most analog and digital logic functions. The mode switch push buttons initiate various operating modes for the microcomputer. Output from the microcomputer can be presented visually on the liquid crystal display (LCD) and audibly on the beeper.

2-3. DETAILED CIRCUIT DESCRIPTION

Each of the functional blocks in Figure 2-1 is discussed in greater detail in the following paragraphs. The schematic diagrams located at the end of this manual can be consulted for details not portrayed in the figures in this section.

2-4. Input Overload Protection

Overload protection for the VΩ→|← input is provided by a network of two metal-oxide varistors (RV1 and RV2), three current-limiting resistors (R1, R2, and RT1), and spark gap E1. The 1 kΩ, 2W fusible resistor R1 opens when an extremely high energy signal is present. Thermistor RT1 rises to a high impedance during a sustained voltage overload in the millivolts dc, ohms, or diode test mode. A voltage clamp network is formed by transistors Q1, Q2, and Q6, diodes CR7 and CR8, and resistor R58. During ohms and diode test overloads, this clamp circuit limits the overload current to U4 at 10 mA. Power supply regulation and system operation is maintained during any of these overloads.

Overload protection for the mA μA input is provided by F1, rated at 1A/600V. The A input is protected by F2, rated at 15A/600V. In addition, the microamp shunt resistors (R4 and R43) are protected from overload currents below the F1 fusing level by the U1 and CR1 diode network.

The 83/85/87 Input-Alert feature provides a beeper warning signal when an input jack is connected to a current input and a non-current function is selected with the rotary switch. The meter detects the presence of an input connection by using split jacks at the mA μA and A inputs. One side of the jack is connected to an overload protection resistor (R7 for mA μA , R10 for A). In turn, R7 and R10 are connected to U4 sense lines AP4 and AP5 (pins 89 and 88). Resistors R8 and R48

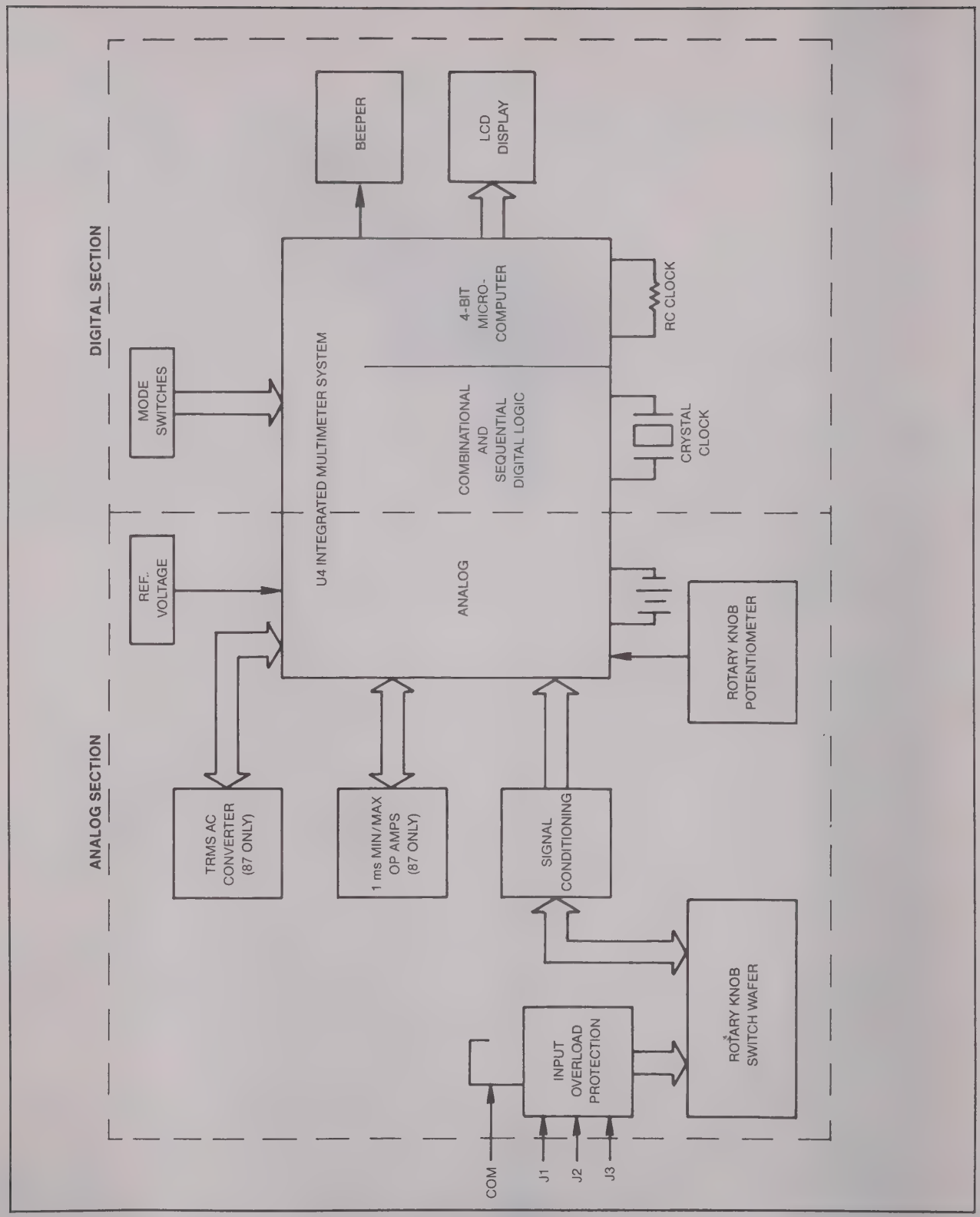


Figure 2-1. Overall Functional Block Diagram

provide Vdd pull up for AP4, and R11 is the pull up resistor for AP5. When a connection is made at mA μA or A , the sense side of the jack is pulled to COM. This condition is detected and compared with the selected function by U4. If a conflict exists, the beeper warning is activated.

2-5. Rotary Knob Switch and Potentiometer

Input signals are routed from the overload protection circuits to a double-sided switch wafer, which provides the necessary switching to implement the various signal conditioning. The function-encoding potentiometer is attached to the associated rotary switch shaft. After turn on, or a knob position change, U4 performs a voltage ratio measurement on this potentiometer to determine the new function.

2-6. Input Signal Conditioning Circuits

Each input signal is routed through signal conditioning circuitry before reaching U4. Input signals received through the VΩ→⊢ input are routed through Z1, a precision resistor network. This input divider network provides precise input scaling for the various voltage ranges and precision reference resistors for the ohms and capacitance functions. The capacitors in parallel with the various resistors in Z1 are used for high frequency compensation.

The input divider is used in two modes. In volts functions, a series mode is used to provide four divider ratios. In the ohms function, a parallel mode provides five reference resistors. During the following discussion, refer to the schematic and signal flow diagrams in Section 5.

2-7. VOLTS

In Volts functions, signal flow for input divider Z1 begins with the unknown voltage at the VΩ→⊢ input, which is connected to the high end of the 9.996 MΩ resistor (pin 1 of Z1) through R1 and RT1. In AC volts, C1 is also connected in series. In DC volts, C1 is shorted by S1 (contacts 3 and 4). Internal switches connect the 9.996 MΩ and 1.1111 MΩ resistors (pin 2 to pin 3 of Z1). The low end of the 1.1111 MΩ resistor (pin 7 of Z1) is connected to COM through S1 contacts 1 and 2, producing the divide-by-10 ratio used in the 400 mV ac, 4V ac, and 4V dc ranges.

For the 40V range, internal switches connect a 101.01 kΩ resistor to provide a divide-by-100 ratio. In the 400V range, 10.01 kΩ is used for a divide-by-1000 ratio. And a 1.0001 kΩ resistor is used in the 1000V range to provide a divide-by-10000 ratio.

The internal switch resistance connecting the 1.1111 MΩ and 9.996 MΩ with the other resistors is approximately 4 kΩ. Since the A/D senses the voltage at APV1 of U4 (pin 3 of Z1), the internal switch resistance adds to the 9.996 MΩ resistor, making for a circuit total of 10 MΩ.

2-8. OHMS

In the 400 ohm range the internal switches connect the 9.996 MΩ resistor (pin 2 of Z1) to the 1.0001 kΩ resistor (pin 6 of Z1); contacts 5 and 3 of S1 connect the remaining ends to of these resistors, making a reference resistor of 1 kΩ. Again, the 4 kΩ internal switch resistance adds to the 9.996 MΩ.

The source voltage is connected internally at both APV0 and APV4 of U4. The current is routed through the 1.0001 kΩ and 9.996 MΩ resistors, into S1 at contacts 3 and 5, out of S1 at contact 4, through R1 and RT1, out the VΩ→⊢ input, through the unknown resistance, and back to COM. The same current flows through the unknown resistance and the reference resistor. The voltage dropped across the unknown resistance is sensed from the VΩ→⊢ input jack through R2 and S1 (contacts 11 and 12) to AP1 of U4.

The A/D senses the voltage drop across the 1K reference resistor through the low (AP2 of U4 through R13) and high (APV0 and APV4) points. These two voltages are used by the A/D Converter to perform a ratiometric measurement.

For the 4 kΩ range, the 10.010 kΩ resistor used in parallel with the 9.996 MΩ resistor forms a 10 kΩ reference resistor. In the 40 kΩ range, 101.01 kΩ and 9.996 MΩ form a 100 kΩ reference resistor. And in the 400 kΩ range, 1.1111 MΩ and 9.996 MΩ provide a 1 MΩ reference resistor. The 4 MΩ and 40 MΩ use only the 9.996 MΩ resistor.

2-9. Analog Section of Integrated Multimeter IC (U4)

The analog-to-digital converter, autorange switching, frequency comparator, and most of the remaining analog circuitry are contained in the analog section of U4. Peripherals to this U4 analog section include the crystal clock, the system reference voltage, and some filter and amplifier resistors and capacitors. Included in the Fluke 87 only is a peripheral 1 ms MIN/MAX circuit and a true rms (root-mean-square) ac-to-dc converter.

Analog-to-digital conversion is accomplished within U4 using the dual-rate, dual-slope a/d converter circuit shown in Figure 2-2. For most measurements, the basic a/d rate cycle lasts 25 ms, for 40 measurements-per-second. A single conversion at this rate is called a minor cycle sample. Each minor cycle sample is used to provide 40 updates-per-minute for the fast response bar graph display, fast MIN/MAX recording, and fast autoranging.

Eight minor cycle samples are necessary to accumulate data for displaying a full-resolution (4000 count full scale)

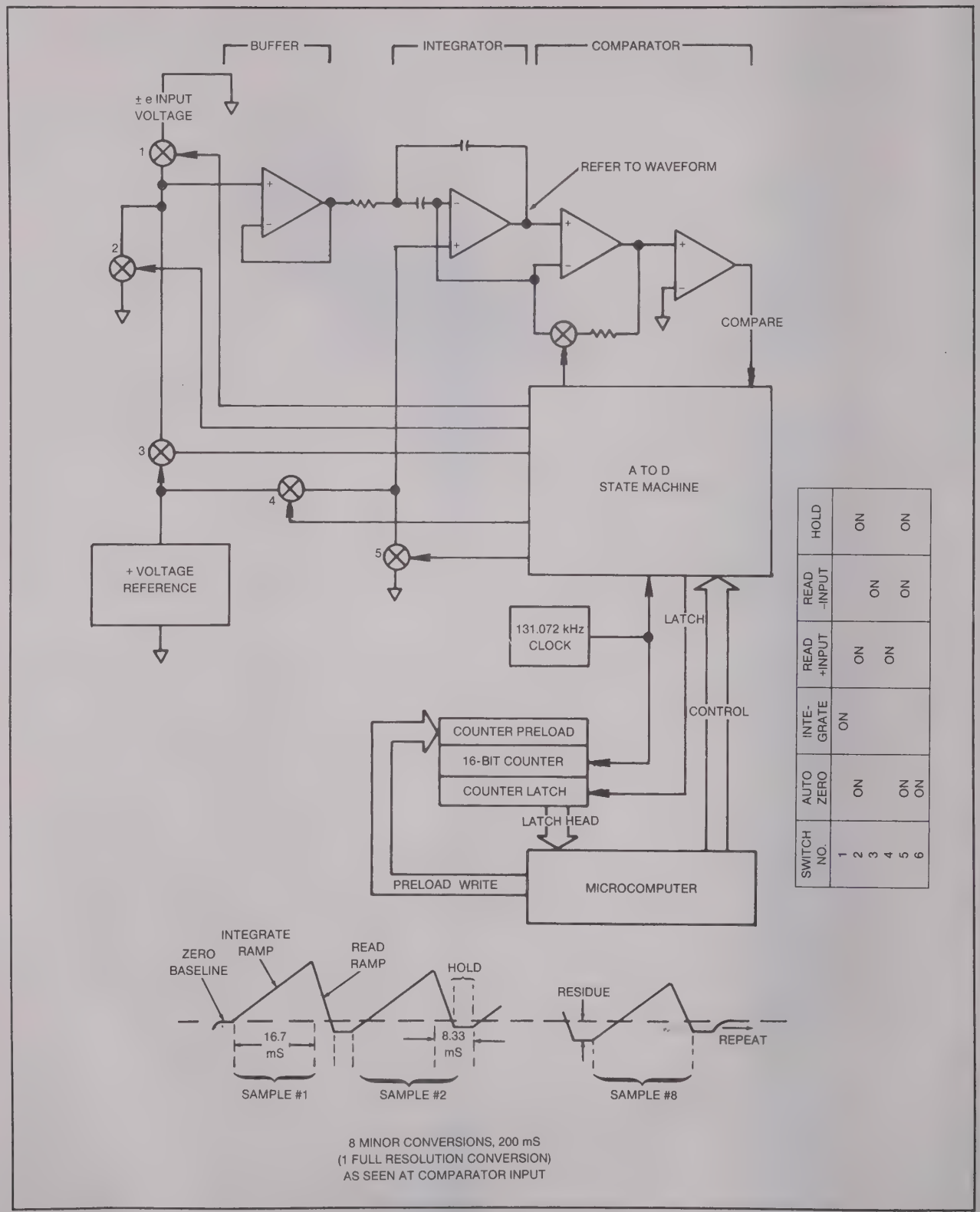


Figure 2-2. A/D Conversion

measurement on the digital display. A 40 ms autozero phase occurs following every eight-sample sequence. Therefore, each digital display update requires 240 ms, approximating 4 updates-per-minute.

Basic a/d conversion elements and waveforms are illustrated in Figure 2-2. As this figure shows, a residual charge is retained by the integrator capacitor due to the overshoot past the true-zero base line. In the absence of an autozero phase, the residual charge would normally produce a significant error in the sample taken next. However, a digital algorithm eliminates the error and accounts for the residual as it propagates through all eight samples.

Basic timing for the a/d converter is defined as a series of eight integrate read cycles, followed by a 40 ms autozero phase. However, the 40 MΩ, capacitance, overload recovery, autoranging, Touch-Hold, 100 ms Min/Max, 1 ms Min/Max (Fluke 87 only), and rotary knob potentiometer modes all require variations from the basic timing.

Capacitance measurements to 5.0 μF are made by measuring the charge required to change the voltage across the unknown capacitor from zero to the system reference voltage. This technique is referred to as a ballistic type of measurement, the elements of which are shown in Figure 2-3. The unknown capacitor is fully charged from zero during the a/d converter integrate cycle. The signal integrated by the a/d converter constitutes the voltage drop across one or more precision resistors (Z1). The reference voltage is the de-integration signal for the a/d. Cx is discharged during de-integrate, hold, and autozero. The microcomputer calculates a display value from the latched count, which is proportional to the unknown capacitance. Capacitance mode uses two samples per display update.

A voltage comparator, with microcomputer configurable offsets, is used for both signal detection in frequency and duty cycle modes and threshold detection in continuity mode. In frequency and duty cycle modes, digital pulses from the voltage comparator are routed to the 16-bit counter.

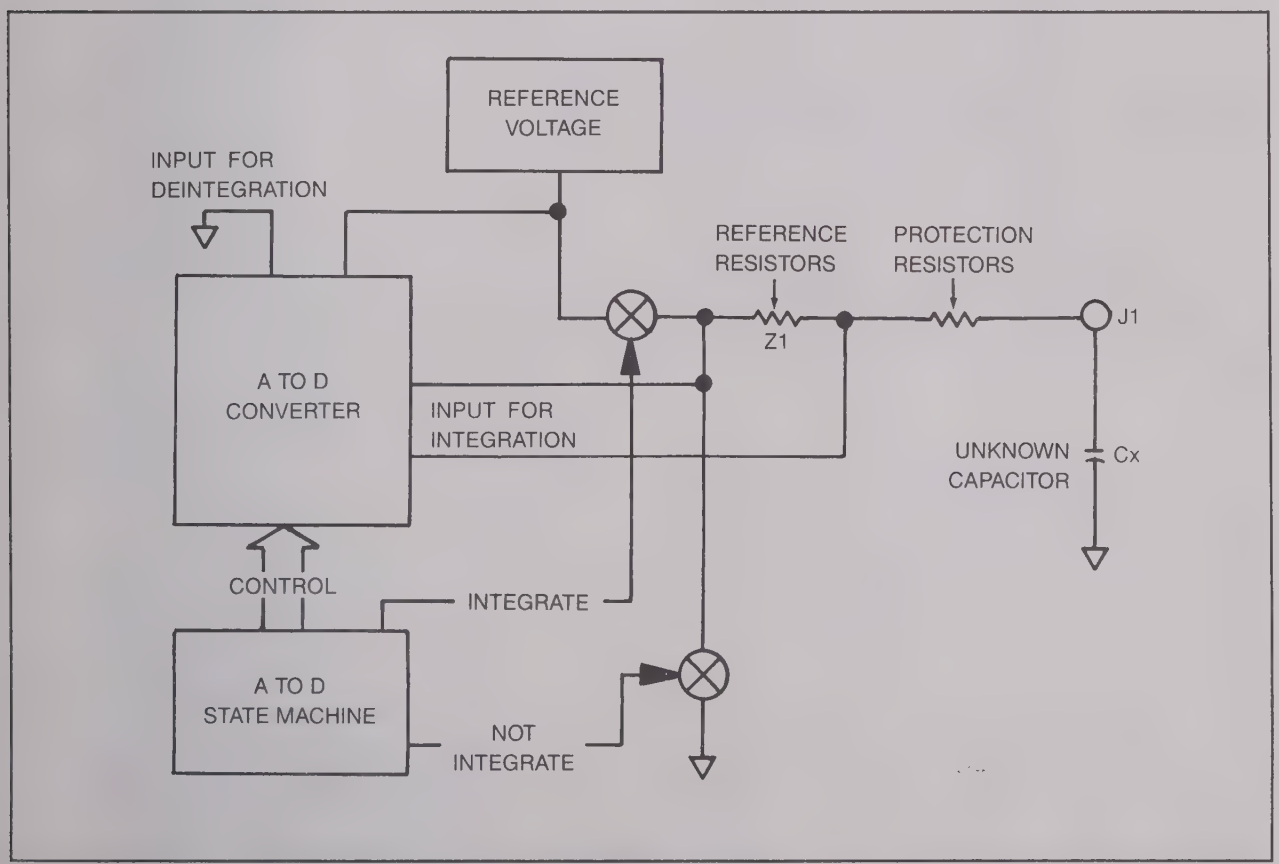


Figure 2-3. Capacitance Measurement Elements

2-10. Digital Section of Integrated Multimeter IC (U4)

Digital circuitry in U4 (excluding the microcomputer) is partitioned into five functional blocks, as shown in Figure 2-4.

- A bus control cell performs address decoding and manages selective power down, split jack sense, and low battery signals.
- The interrupt control cell manages and multiplexes four interrupts to the microcomputer. These interrupts are for 16-bit and 8-bit counter carries and voltage comparator transitions.
- A 48-bit write-only register latches microcomputer data for analog switch drive.
- A 16-bit counter (with parallel preload and latch registers) is used as a read counter for a/d conversions and as a pulse counter for frequency and duty-cycle measurements.
- The a/d converter is controlled by a 4-bit state machine with output decoding ROM.

Figure 2-5 is a block diagram of frequency counter components. For frequency and duty cycle measurements, the 16-bit counter in the digital section of U4 is partitioned into two 8-bit counters. Each of these counters is then extended to 20 bits using microcomputer software and hardware. The gating logic controls the start and stop of each reading. In frequency mode, signal A is the unknown frequency, and signal B is the crystal clock signal. After enough counts have been accumulated in each 20-bit register, the microcomputer calculates the unknown frequency from the ratio of the counter values.

In making a duty cycle measurement, signal A (Figure 2-5) is again the unknown signal, but signal B is the logical AND of the unknown and reference signals. As with frequency measurement, the microcomputer controls the start and stop of a measurement cycle via the gating logic. The ratio of the counter values yields the duty cycle value.

2-11. Microcomputer Control

A 4-bit microcomputer, integrated within U4, controls the various instrument functions and drives the display. A/D converter and counter measurements are controlled via the microcomputer interface lines shown in Figure 2-4. Min/Max, Touch-Hold, and REL (relative) modes involve additional data processing by the microcomputer to generate the display value.

The microcomputer/digital logic interface consists of both RAM that has been mapped into the digital logic and an interrupt line back to the microcomputer. The four interrupts are maskable, readable, and resettable. Note that the microcomputer runs on its own RC clock at a frequency of 525 to 800 kHz and is asynchronous from the crystal clock.

The microcomputer exercises direct control over the ranging and signal routing analog switches. A specific word is written to the switch drive register for each function/range selection. In autoranging (default) mode, the microcomputer determines the correct range based on the input. In addition, for autoranging during voltage, ohms, or current measurements, the active filter fast mode is enabled for quick response. In frequency or duty cycle mode, pushing the range button causes a range change in the primary function (volts, amps, etc.) that may change the sensitivity or offset.

The microcomputer sets the required a/d converter mode, which determines the on-chip analog signal ports to be used for the integrate and de-integrate signals. The microcomputer also selects one of the three available gain resistors in Z1 for integrate and de-integrate. All voltage and current conversions use either a 400 mV or a 40 mV full scale mode. Other modes are used for ohms, hiohms, 40 MΩ, nS, and capacitance. Since the a/d state machine timing is under direct software control, a mode invoked in another function or range can use different timing.

Frequency measurements are also controlled by the microcomputer section of U4. The microcomputer initializes the counters, monitors the count accumulation, arms and disarms the logic signal gating, and calculates the display value from the counter values.

Min/Max Record (1s and 100 ms), Touch-Hold, and Relative are secondary software functions. This means that the microcomputer performs either a different control algorithm or a different math routine on the data, as explained below.

- In Min/Max Record mode, the maximum and minimum readings after initialization are stored in memory, and a true running average is calculated after each reading. The running average is updated for a maximum of 36 hours. The MIN MAX button allows the user to scroll through the min, max, average, and present readings. In 100 ms Min/Max a single sample is used to calculate the display value, while in 1s Min/Max a full resolution conversion is used. Note that 1 ms Peak Min/Max (Fluke 87 only) requires additional analog peak hold amplifiers external to U4.

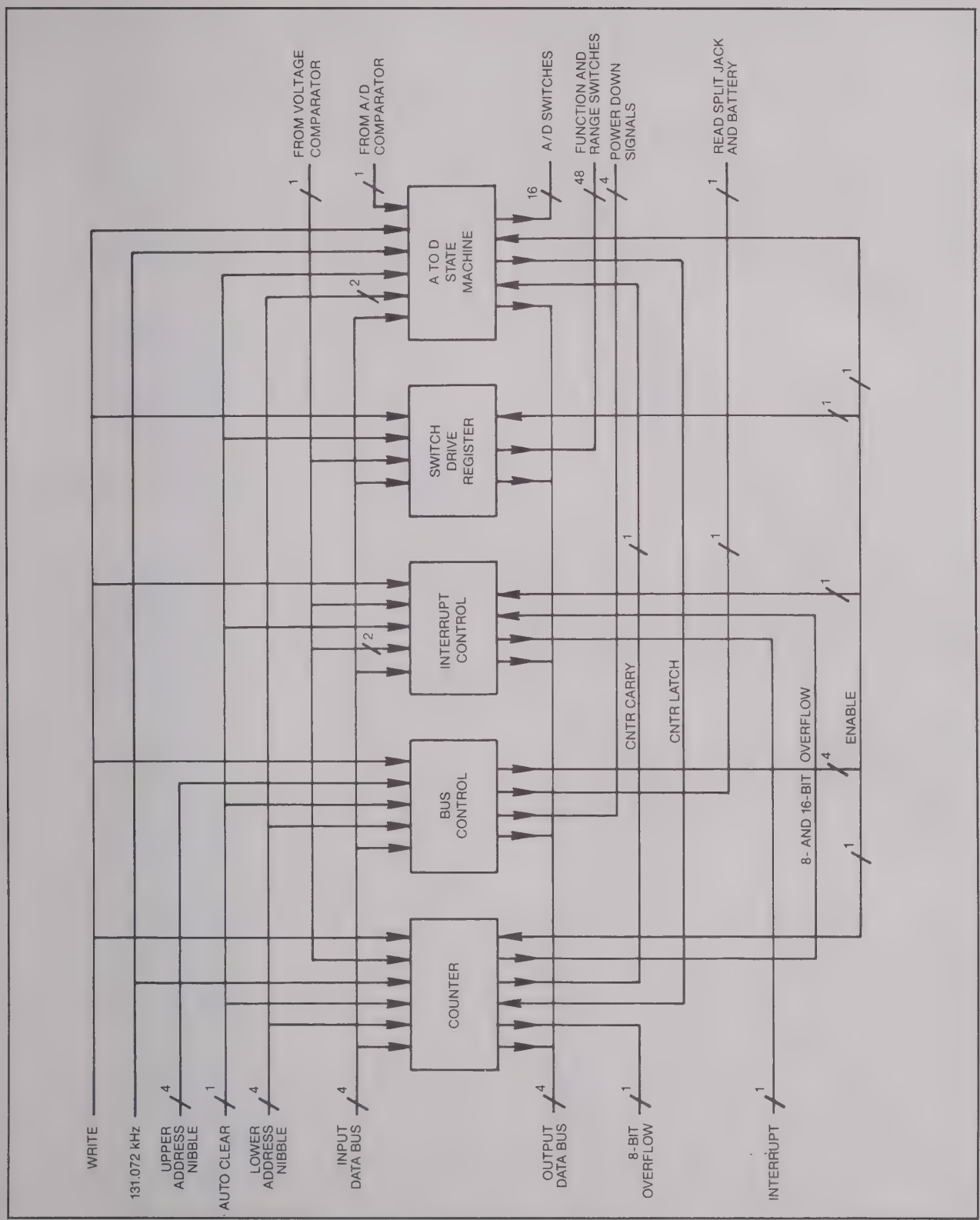


Figure 2-4. Digital Circuitry Within U4

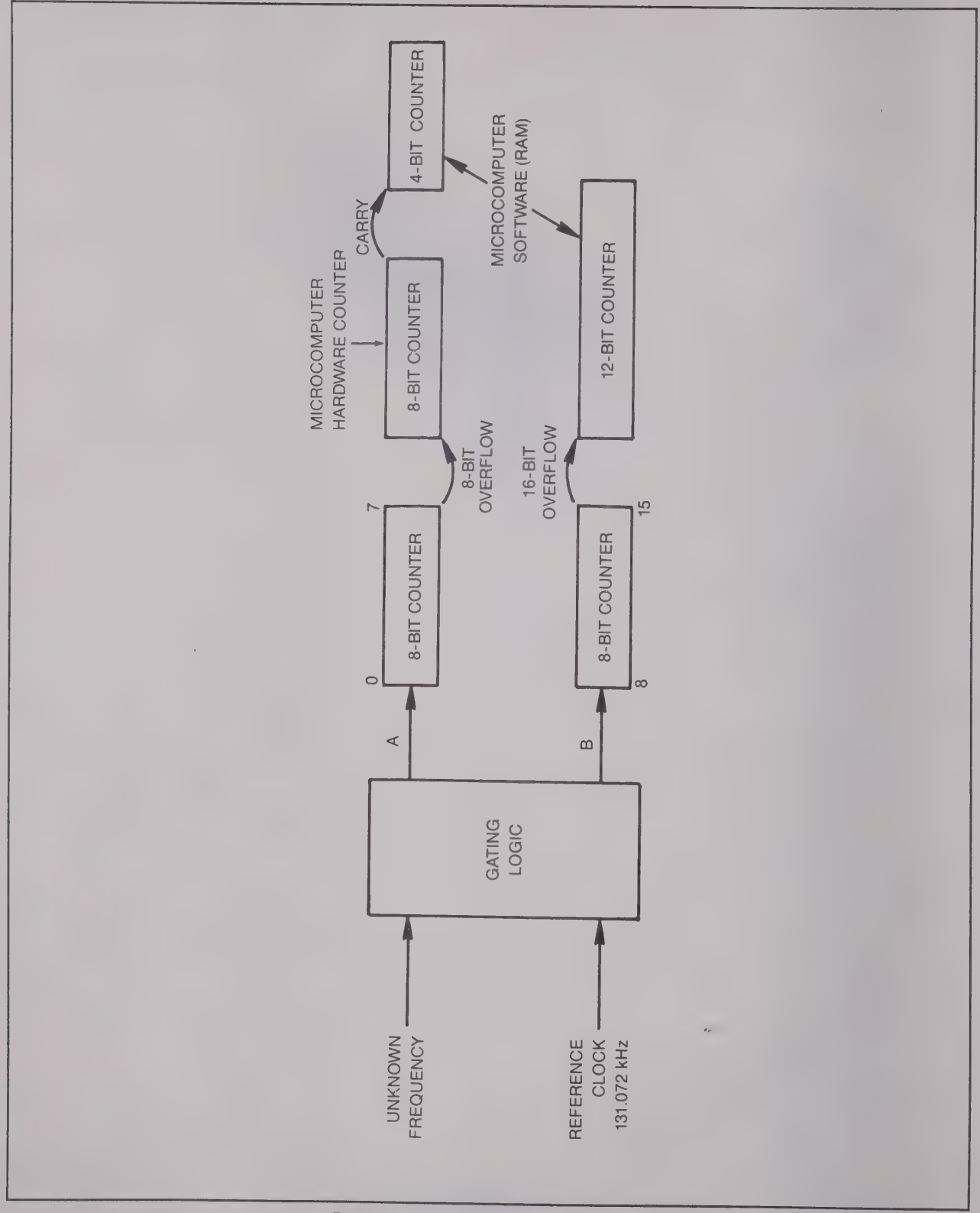


Figure 2-5. Frequency Counter Elements

- When Touch-Hold is selected, the microcomputer does not allow a full resolution conversion to be completed unless the input signal is stable. When a stable reading occurs, the conversion is completed, and the microcomputer generates and freezes the corresponding display. The microcomputer now waits for a change in the signal to exceed a certain threshold, then begins watching for a stable reading again. Note that a reading is forced when Touch Hold is first selected. Also, open test lead signals do not update the display.

- With the REL button (relative) selected, the microcomputer stores the present reading as an offset. This value is subtracted from all subsequent readings (provided that they are on scale) to give the display value.

2-12. Peripherals to U4

In addition to input overload protection and input signal conditioning circuits, other devices peripheral to U4 are needed to support 80 series features. The ac converter, active filter, and a/d converter circuits require off-chip resistors and capacitors. Digital drive and level-shifting circuits are needed for the beeper drive, quick turn off, true RMS converter power down (Fluke 87 only), and LCD back light (also Fluke 87 only) features. A voltage reference is generated separate from U4, and some discrete resistors and transistors support the power supply. The Fluke 87 also uses two analog peak hold circuits (1 ms Min/Max).

2-13. AC BUFFER

The ac buffer circuit differs between the Fluke 83/85 and the Fluke 87. On the Fluke 83/85, R14, R15, C5, and C27 are part of the ac buffer circuit that drives the ac converter and guard. The Fluke 83/85 ac buffer can be configured for an ac gain of 1 or 10. For the Fluke 87, R14, R15, R46, C5, and C27 support the ac buffer. This buffer can be configured for an ac gain of ½, 1, 5, or 10. The gains of ½ and 5 are needed for the true rms converter, which uses a 200 mV full scale input. In the Fluke 87, the ac buffer drives the rms ac converter, guard, and peak hold amplifiers.

2-14. AC CONVERTER

The Fluke 83/85 average ac converter uses off-chip components R30, R31, R34, R40, C24, C28, and C29. This ac converter is a full-wave rectifying converter with a differential output and gain selected to give a dc output equal to the rms value for a sine wave input. Filtering is provided by C28 and C29.

2-15. RMS CONVERTER

The Fluke 87 uses an integrated rms-to-dc converter (U2). Devices R34, R45, C6, and C7 support U2, while Q4, R32, and R39 drive the power on/off pin.

2-16. ACTIVE FILTER

On all models, the active filter uses off-chip passive components R17, R18, C8, and C9. The active filter is a second order low pass filter with two poles at 5.9 Hz in normal mode. It filters input signal noise and ac ripple from the ac converter, yielding stable a/d converter readings. The microcomputer can disable the filter completely or enable the filter fast response mode.

2-17. A/D CONVERTER

Pins 8, 9, and 10 on precision resistor network Z1 connect to the three a/d converter gain resistors. Pin 8 connects to 190 kΩ for a gain of 0.87. Pin 9 connects to 160 kΩ for a gain of 1, and pin 10 connects to 16 kΩ for a gain of 10. Pin 11 is the common connection. The autozero capacitor (C10) stores op amp and comparator offsets. The integration capacitor is C11.

2-18. BEEPER

Devices Q9, Q11, R56, R57 and CMOS hex inverter U6 make up the double-ended beeper drive circuit. Transistor Q12 is connected to provide quick microcomputer power down when the instrument is turned off.

The system reference voltage (1.235V) is generated by VR1 and R44. The 1.000V reference voltage for the a/d converter is supplied through U4-1 (REFI). This voltage is adjusted by R21, the dc calibration potentiometer. In addition to generating the a/d reference, the VR1 voltage is used for power supply reference, voltage comparator selectable offset generation, and the ohms source level.

2-19. POWER SUPPLY

The power supply consists of two regulators, one shunt and one series, which set Vdd at +3.0V and Vss at -3.2V for all battery voltages down to 6.7V. The shunt (common) regulator sets Vdgnd - Vss (Vdgnd = COM = 0V) and consists of an uncompensated op amp and large current shunt devices integrated on U4. Resistors R37 and R38 provide voltage division. The series (Vdd) regulator, which sets Vdd - Vdgnd , is made up of another on-chip, uncompensated op amp, along with devices Q3, R24, and R25. Q3 is the series regulator element, and R24 and R25 are for voltage sensing. Capacitors C14 and C21 provide circuit compensation and power supply decoupling for the shunt and series regulators, respectively. Voltage level information is presented in Table 2-1.

Table 2-1. Typical Voltage Levels and Tolerance

VDD	3.0 ±0.3
VSS	-3.2 ±0.3
VBT+	3.5 ±0.3
VBT-	-3.5 (battery at full 9V charge)
	3.0 (battery at low charge of 6.5V)
REFH	1.235 ±0.012
PS0	1.235 ±0.15
PS1	0 ±0.15
AP6	-0.5 to -0.15
VOA	2.2 to 1.7 (referenced from VSS)
VOB	1.07 to .91 (referenced from VSS)

2-20. PEAK HOLD

The 1ms Min/Max mode on the Fluke 87 is implemented using the peak hold circuit consisting of the dual op amp package AR1, diodes CR2 and CR3, C12, C13, R22, and R23. The op amp connected to CR2 charges C12 to the most positive voltage at its input after initialization (which can be positive or negative in amplitude.) CR2 prevents C12 from being discharged after the peak input is no longer present. The op amp connected to CR3 works in a similar fashion, but captures negative peaks. Upon selection of 1ms Min/Max, U4 initializes the circuit by connecting AP7 (pin 86) to Vss and AP8 (pin 85) to Vdd via on-chip switches. Leakage currents are controlled so that the voltages on C12 and C13 drift towards the AR1 op amp input level. The voltages stored on C12 and C13 are read, in a single sample, to give the display minimum and maximum values.

2-21. Display

The liquid-crystal display (LCD) operates under direct control of the microcomputer. Characters are generated by the computer and displayed on the LCD. Both digital readings and an analog bar-graph (or pointer for Fluke 87) display are presented, in conjunction with annunciators and decimal points. The Fluke 87 features a transflective LCD with a light-emitting diode (LED) back light. Refer to the Fluke 83/85 or 87 Operator's Manual for a more detailed description of the display.

static awareness

A Message From

John Fluke Mfg. Co., Inc.

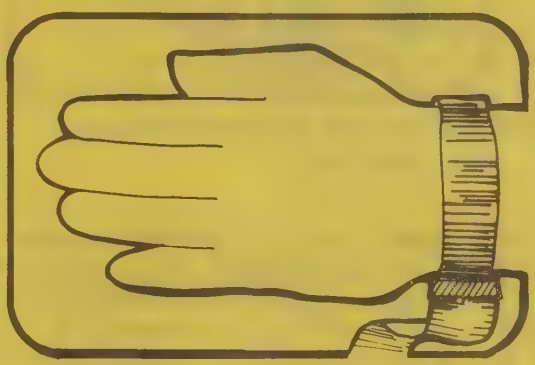
Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

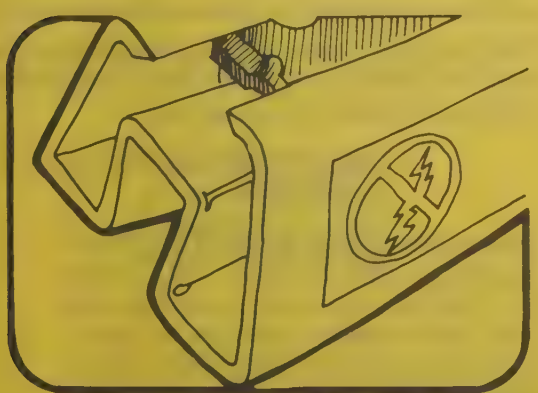
The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol "⊗"

The following practices should be followed to minimize damage to S.S. devices.

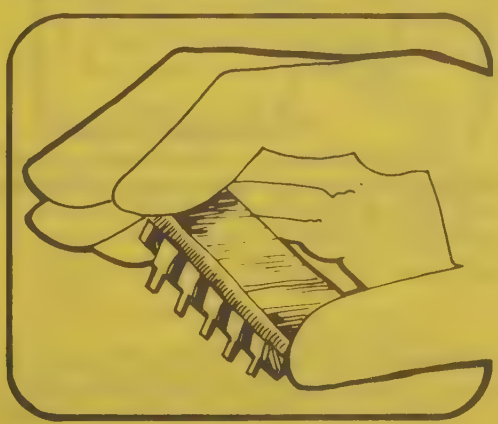
1. MINIMIZE HANDLING



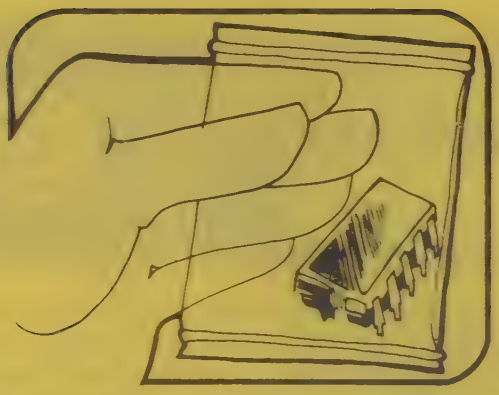
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES. USE A HIGH RESISTANCE GROUNDING WRIST STRAP.



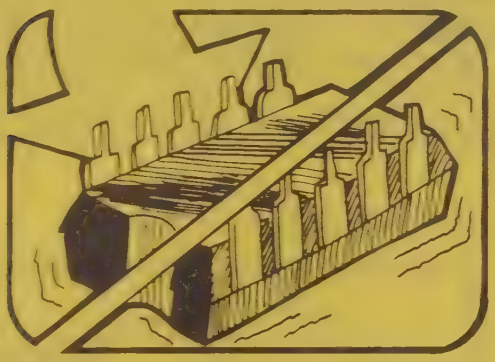
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



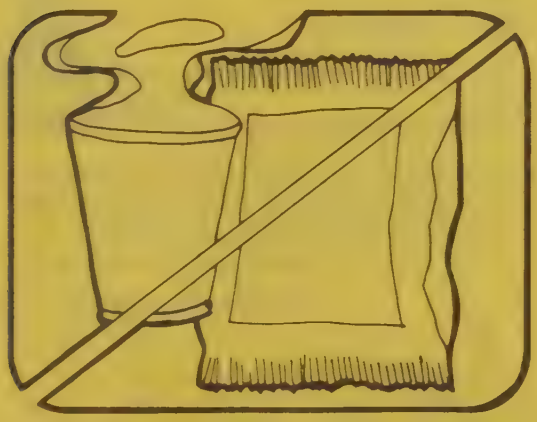
4. HANDLE S.S. DEVICES BY THE BODY



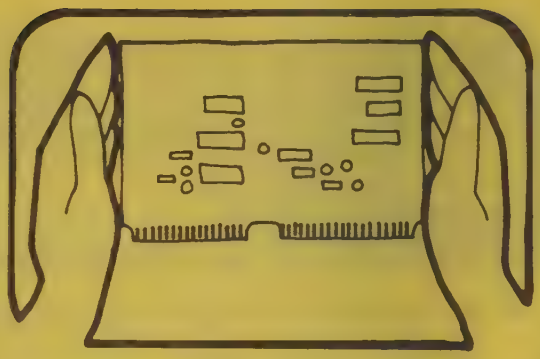
5. USE STATIC SHIELDING CONTAINERS FOR HANDLING AND TRANSPORT



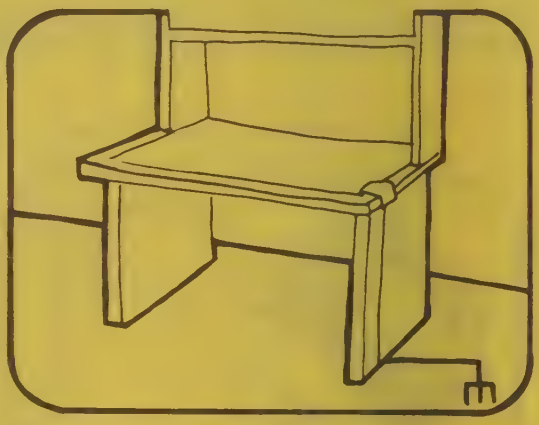
6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE



7. AVOID PLASTIC, VINYL AND STYROFOAM® IN WORK AREA



8. WHEN REMOVING PLUG-IN ASSEMBLIES, HANDLE ONLY BY NON-CONDUCTIVE EDGES AND NEVER TOUCH OPEN EDGE CONNECTOR EXCEPT AT STATIC-FREE WORK STATION. PLACING SHORTING STRIPS ON EDGE CONNECTOR HELPS TO PROTECT INSTALLED SS DEVICES.



9. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION
10. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.
11. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

A complete line of static shielding bags and accessories is available from Fluke Parts Department, Telephone 800-526-4731 or write to:

JOHN FLUKE MFG. CO., INC.
PARTS DEPT. M/S 86
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EVERETT, WA 98204

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® Dow Chemical

J0089D-07U8604/SE EN Litho in U.S.A.
Rev. 1 MAR 86

Section 3
Maintenance

WARNING

SERVICING DESCRIBED IN THIS SECTION IS TO BE PERFORMED BY QUALIFIED SERVICE PERSONNEL ONLY. TO AVOID ELECTRICAL SHOCK, DO NOT PERFORM ANY SERVICING UNLESS YOU ARE QUALIFIED TO DO SO.

3-1. INTRODUCTION

This section of the 80 Series Service Manual provides procedures in the following areas:

- Routine and preventive maintenance.
- Performance verifications.
- Calibration.
- Troubleshooting (to the component level.)

3-2. REQUIRED TOOLS AND EQUIPMENT

Required equipment is listed in Table 3-1. If the recommended models are not available, equipment with equivalent specifications may be used. Repairs or servicing should be performed only by qualified personnel.

3-3. OPERATOR MAINTENANCE

WARNING

TO AVOID ELECTRICAL SHOCK, REMOVE THE TEST LEADS AND ANY INPUT SIGNALS BEFORE REPLACING THE BATTERY OR FUSES. TO PREVENT DAMAGE OR INJURY, INSTALL ONLY QUICK ACTING FUSES WITH THE AMP/VOLT RATINGS SHOWN IN FIGURE 3-1.

3-4. Case Disassembly

Use the following procedure to disassemble the Multimeter.

1. Disconnect test leads from any live source, turn the rotary switch to OFF, and remove the test leads from the front terminals.

2. The case rear is secured to the case front by three screws and two internal snaps (at the LCD end). Using a Phillips-head screwdriver, remove the three screws from the case rear.

NOTE

The gasket between the two case halves is sealed to, and must remain with, the lower case half. The upper case half lifts away from the gasket easily. Do not damage the gasket or attempt to separate the lower case half from the gasket.

3. Now turn the case over (display side up), and, lifting up on the input terminal end, disengage the upper case half from the gasket. Gently unsnap the upper case half at the display end. See Figure 3-2.

CAUTION

With its case removed, the Multimeter presents exposed circuit connections. To avoid unintended circuit shorting, always place the uncovered multimeter assembly on a protective surface.

3-5. Circuit Assembly Removal and Installation

Once the outer case has been removed, the circuit assembly can be disconnected from its covering shields with the following procedure:

Table 3-1. Required Equipment

EQUIPMENT	REQUIRED CHARACTERISTICS	RECOMMENDED MODEL
DMM Calibrator	AC Voltage Range: 0-1000V ac Accuracy: ±.2% Frequency Range: 60-20000 Hz Accuracy: ±1% DC Voltage Range: 0-1000V dc Accuracy: ±.05% Current Range: 350 μA-35 mA Accuracy: ±.2%	Fluke 5100B, 5101B, or 5102B
Function Generator		Philips PM 5193
Power Amplifier	Range: to 1000V dc Accuracy: 50 Hz to 10 kHz: ±(800 ppm + 100 mV) 10 to 50 kHz: ±(1200 ppm + 150 mV)	Fluke 5205A
Resistance Calibrator	Range: 1Ω-100 MΩ Accuracy: .065%	Fluke 5450A
Decade Capacitor	Range: 5 nF to 1 μF Accuracy: ±.35%	Genrad 1413 or 1423
Transconductance Amplifier	Current Range: 10A Accuracy: AC (60 Hz to 1 kHz): ±.3% DC: ±.1%	Fluke 5220A

EQUIPMENT USAGE IN PERFORMANCE TESTS

	TRANSCON-DUCTANCE AMPLIFIER	CALIBRATOR	FUNCTION GENERATOR	POWER AMPLIFIER	RESISTANCE CALIBRATOR	DECADE CAPACITOR
AC Voltage		X		X		
Frequency						
Accuracy			X			
Sensitivity			X			
Trigger Level			X			
DC Voltage		X				
1-Ms MIN MAX		X				
mV DC		X				
Ohms					X	
Capacitance						X
Diode		X				
mA		X				
μA		X				
A	X					

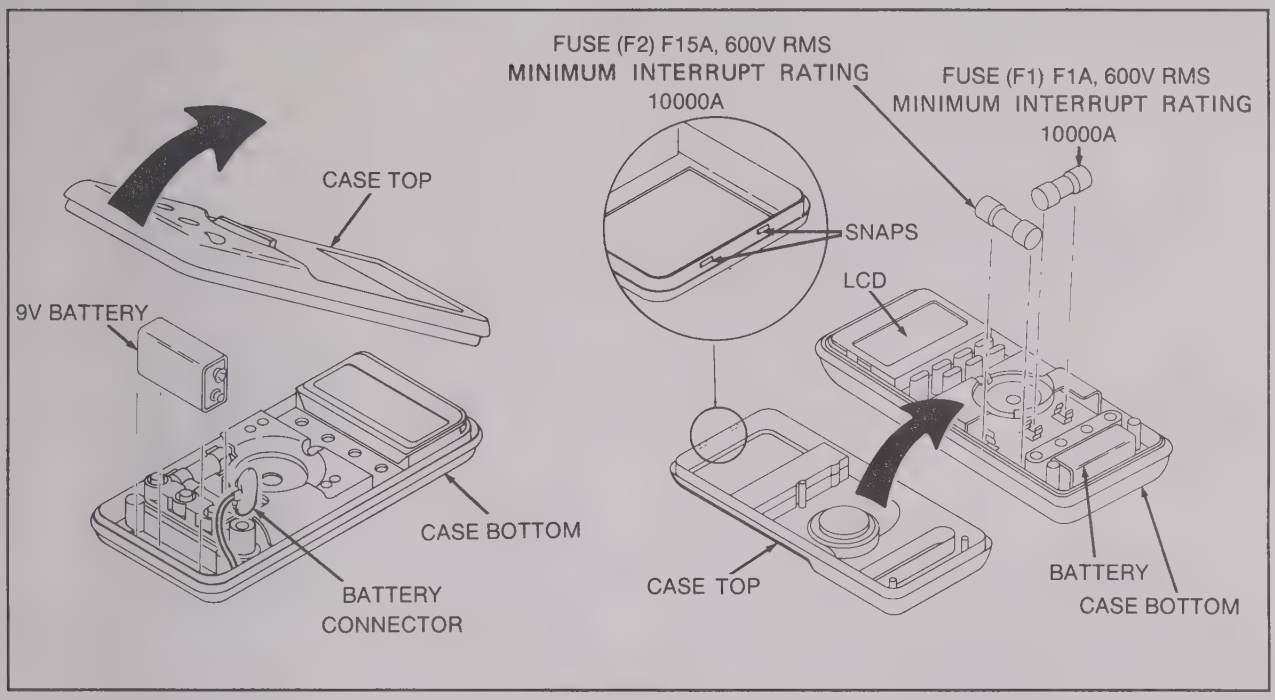

Figure 3-1. Battery and Fuse Replacement

1. Remove the one Phillips-head screw securing the back shield to the circuit assembly. Then remove the back shield.

2. The front shield can now be disconnected from the circuit assembly by detaching the four snaps (one at a time) found on the top-front.

CAUTION

Be gentle when detaching or attaching the four securing snaps. Excessive force can deform or fracture the snaps.

3. To reattach the circuit assembly, push the front shield on so that the four clips engage gently and simultaneously. Then turn the assembly over, and replace the Phillips-head screw and back shield.

NOTE

Ensure that the shields are tightly attached. Accurate multimeter operation relies on properly fitted shields.

3-6. Case Reassembly

Use the following procedure to reassemble the Multimeter.

1. Check that the case top rotary switch and circuit board switch are in the OFF position.

2. Ensure that the gasket remains secured to the lower case half. Then, starting with the two snaps at the display end and finishing at the terminal end, cradle the upper case half into the gasket.

3. Reinstall the three screws from the lower case half.

4. Repeat the Performance Test (found in this section of the manual) after reassembly.

3-7. Battery Replacement

The meter is powered by a single 9V battery (NEDA 1604, 6F22, or 006P). Referring to Figure 3-1, use the following procedure to replace the battery:

1. Remove the multimeter case as described under Case Disassembly.

2. Lift the battery from the case bottom, and carefully disconnect the battery connector leads.

3. Snap the battery connector leads to the terminals of a new battery and reinsert the battery into the case bottom. Dress the battery leads so that they will not be pinched between the case bottom and case top.

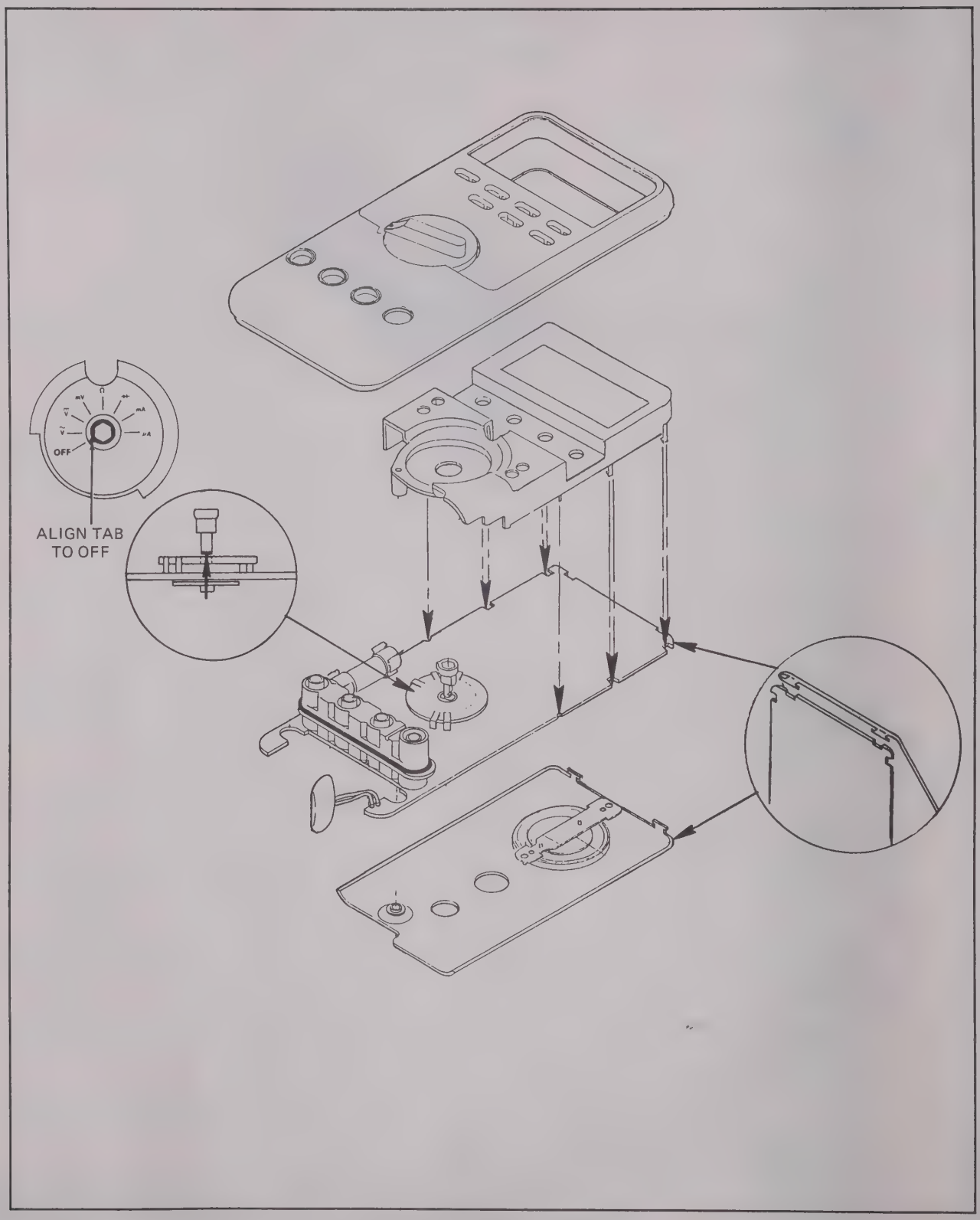

Figure 3-2. Assembly Details

4. Reassemble the Multimeter as described under Case Reassembly.

3-8. Fuse Test

Use the following procedure to test the internal fuses of the meter.

1. Turn the rotary selector switch to the))))) Ω ⊣⊢ position.

2. Plug a test lead into the VΩ→⊢ input terminal, and touch the probe to the [A] input terminal. Because the receptacles of the input terminals contain split contacts, be sure that you touch the probe to the half of the receptacle contact that is nearest the LCD.

3. The display should indicate between 00.0 and 00.5 ohms. This tests F2 (15A, 600V). If the display reads OL (overload), replace the fuse and test again. If the display reads any other value, further servicing is required.

4. Move the probe from the A input terminal to the mA μA input terminal.

5. The display should read between 0.995 kilohms and 1.005 kilohms. This procedure tests F1 (1A, 600V). If the display reads a high resistance or OL (overload), replace the fuse and test again. If the display reads any other value, further servicing is required.

3-9. Fuse Replacement

Referring to Figure 3-1, use the following procedure to examine or replace the meter's fuses:

1. Perform steps 1 through 3 of the battery replacement procedure.

2. Remove the defective fuse by gently prying one end of the fuse loose and sliding the fuse out of the fuse bracket.

3. Install a new fuse of the same size and rating. Make sure the new fuse is centered in the fuse holder.

4. Ensure that the case top rotary switch and circuit board switch are in the OFF position.

5. Ensure that the gasket remains secured to the lower case half. Then, starting with the two snaps at the display end and finishing at the terminal end, cradle the upper case half into the gasket.

6. Reinstall the three screws from the lower case half.

3-10. Cleaning

WARNING

TO AVOID ELECTRICAL SHOCK OR DAMAGE TO THE METER, NEVER ALLOW WATER INSIDE THE CASE. TO AVOID DAMAGING THE METER'S HOUSING, NEVER APPLY SOLVENTS TO THE METER.

If the meter requires cleaning, wipe it down with a cloth that is lightly dampened with water or a mild detergent. Do not use aromatic hydrocarbons, chlorinated solvents, or methanol-based fluids when wiping down the meter.

3-11. INPUT TERMINALS

Water, dirt, or other contamination in the A or mA μA terminals may activate the Input Alert (beeper) feature even though test leads are not inserted. With all test leads removed, such contamination might be dislodged by turning the multimeter over and gently tapping on the case. However, the following procedure is recommended as a much more effective treatment:

1. Turn the multimeter off and remove all test leads.

2. Use a clean swab in each of the four terminals to dislodge and clean out the contamination.

3. Moisten a new swab with a cleaning and oiling agent (such as WD40). Work this swab around in each of the four terminals. Since the oiling agent insulates the terminals from moisture-related shorting, this preventive treatment ensures against future erroneous Input Alerts.

3-12. ROTARY SWITCH

Clean the rotary knob potentiometer used by function selector switch S2 with the following procedure:

1. Remove the circuit assembly as described earlier in this section (Circuit Assembly Removal and Installation).

2. From the back of the circuit assembly, push the switch shaft in, and remove the polymer thick film (ptf) contact assembly.

3. Clean the ptf contact assembly and the potentiometer on the circuit assembly with alcohol. Blow these parts dry with clean, dry air.

4. Push and secure the ptf contact assembly back on the switch shaft.

5. Reassemble the circuit assembly, shields, and case parts as described earlier in the section (Case Reassembly).

6. Repeat the Performance Test after reassembly.

3-13. PERFORMANCE TEST

Basic operability of an 80 Series Multimeter can be checked by turning the rotary switch to Ω and connecting a test lead from the VΩ→⊢ input to the mA μA input. (If you are using a test probe, touch the half of the input contact nearest the LCD.) The display should read 1.000 kΩ ± 5 digits. With the rotary switch still at Ω, test the A fuse (15A) by inserting the plug end of the test lead into the A input; then test the mA μA fuse (1A) by inserting the plug end of the test lead into the mA μA input. The beeper emits an Input Alert if the fuses are good.

A more involved operability and accuracy check is detailed in the following paragraphs. Each function is checked for accuracy to the specifications listed in Section 1 of this manual. Note that for performance verification purposes, the case covers do not need to be removed and no adjustments are necessary. Merely make the input connections called for, and check the display for accuracy.

3-14. Setup

Equipment setup is defined for each accuracy verification procedure. Equipment requirements are presented in Table 3-1. Accuracy figures are valid for a period of one year after calibration, when measured at an operating temperature of 18 to 28 degrees C and at a maximum of 90% relative humidity.

3-15. Display Test

Switch the meter on and compare the display with the appropriate example in Figure 3-3. Hold any button down to hold the instrument in Display Test.

3-16. Rotary Switch Test

This test verifies correct operation of the rotary function selector switch. Internally, the selector circuit relies on the interface between a ptf region on the circuit assembly and a rotating contact assembly on the switch shaft. The rotary switch test exercises this interface by checking the various range codes and displaying their representative numbers.

To enter the rotary switch test mode, hold down the RANGE button while turning the rotary switch from OFF to V⎓ . Normal meter functions are now disabled, and a number appears in the display. Refer to Table 3-2. Continue rotating the switch one function at a time, checking for appropriate number displays. To exit the Rotary Switch mode, turn the rotary switch first to OFF, then (without holding down the RANGE button) back to any function selection.

Table 3-2. Rotary Switch Test

FUNCTION	DISPLAY (±12)	FUNCTION	DISPLAY (±12)
OFF	n/a	OHMS	-96
ACV	0	DIODE	-128
DCV	-32	mA/A	-160
mV DC	-64	μA	-192

3-17. AC Voltage Test

Use the following procedure to verify accuracy in the ac voltage ranges.

1. Connect the Calibrator to the VΩ→⊢ and COM inputs on the Multimeter.

2. Set the Calibrator for the voltage and frequency called for in step 1 of Table 3-3. Check that the multimeter display is within the limits shown for your 80 Series Multimeter (Model 83, 85, or 87).

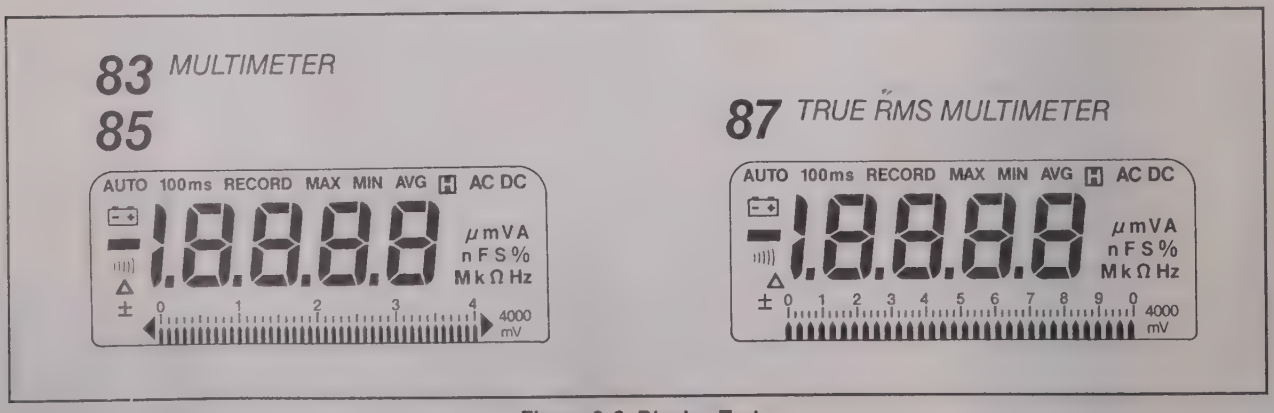

Figure 3-3. Display Test

Table 3-3. AC Voltage Test

STEP	INPUT		DISPLAY READING		
	VOLTAGE	FREQUENCY	83	85	87
1	350 mV	60 Hz	346.1 to 353.9	347.9 to 352.2	347.2 to 352.9
2	350 mV	5 kHz	344.4 to 355.7	346.1 to 353.9	346.1 to 353.9
3	350 mV	20 kHz	n/a	342.6 to 357.4	342.6 to 357.4
4	3.500V	60 Hz	3.462 to 3.538	3.481 to 3.520	3.474 to 3.527
5	3.500V	5 kHz	3.444 to 3.556	3.464 to 3.537	3.461 to 3.539
6	3.500V	20 kHz	n/a	3.356 to 3.644	3.426 to 3.574
7	35.00V	60 Hz	34.62 to 35.38	34.81 to 35.20	34.74 to 35.27
8	35.00V	5 kHz	34.44 to 35.56	34.63 to 35.37	34.61 to 35.39
9	35.00V	20 kHz	n/a	33.56 to 36.44	34.26 to 35.74
10	350.0V	60 Hz	346.2 to 353.8	348.1 to 352.0	347.4 to 352.7
11	350.0V	5 kHz	344.4 to 355.6	346.3 to 353.7	346.1 to 353.9
12	100.0V	20 kHz	n/a	95.6 to 104.4	97.6 to 102.4
13	200.0V	20 kHz	n/a	191.6 to 208.4	195.6 to 204.4
14	300.0V	20 kHz	n/a	287.6 to 312.4	293.6 to 306.4
15	350.0V	20 kHz (10kHz)	n/a	335.6 to 364.4	342.6 to 357.4
16	1000V	60 Hz	987 to 1013	993 to 1007	991 to 1009
17	1000V	5 kHz	972 to 1028	978 to 1022	986 to 1014

Table 3-4. Frequency Test

STEP	SINE WAVE INPUT		DISPLAY READING 83/85/87
	VOLTAGE	FREQUENCY	
1	150 mV rms	19.000 kHz	18.998 to 19.002
2	150 mV rms	190.00 kHz	189.98 to 190.02

3. Repeat this procedure for steps 2 through 9 of Table 3-3.

4. Now connect the Power Amplifier between the Calibrator and the Multimeter.

5. Check for display accuracy at each input called for in steps 10 through 17 of Table 3-3.

3-18. Frequency Test

The following procedure verifies Multimeter accuracy in Frequency mode.

1. Connect the Function Generator to the VΩ→|← and COM inputs on the Multimeter. Note that the frequency accuracy of the Function Generator used must be appropriate for the specified accuracy of the Multimeter.

2. With the Multimeter in the 400 mV ac range, press the HZ button to enter the Frequency Counter mode.

3. Set the Function Generator for the sine wave voltage and frequency called for in step 1 of Table 3-4. Check for a reading within the limits shown.

3-19. Frequency Sensitivity and Trigger Level Test

The following procedure verifies the counter sensitivity and trigger levels. For any function and range, the sensitivity and trigger level is the same in both frequency and duty cycle modes.

1. Connect the Function Generator to the VΩ⊣◀ and COM inputs on the Multimeter.
2. Select the 400 mV ac range, and press the HZ button twice to choose Duty Cycle mode.
3. Apply the input from step 1 of Table 3-5, and check for the called-for response on the Multimeter.
4. On the Multimeter, press the RANGE button to enter the 4V ac range. The annunciator on the right side of the bar graph displays the present range.
5. Apply the step 2 input, and check for the desired reading.
6. Select the 4V dc range, and press the HZ button twice to choose Duty Cycle mode.
7. Apply the input from step 3 of Table 3-5, and check for the called-for response on the Multimeter.
8. On the Multimeter, press RANGE button to enter the 40V dc range.
9. For each of steps 4, 5, 6, 7, and 8, apply the indicated input and check for the appropriate reading.

3-20. DC Voltage Test

Use this procedure to verify accuracy in the dc voltage function. Note that a separate verification procedure for dc millivolts (mV) is provided later in this section.

1. Connect the Calibrator to the VΩ⊣◀ and COM inputs on the Multimeter.
2. Rotate the multimeter function control to V⎓ .
3. Check for the multimeter response called for in each step of Table 3-6.

Table 3-5. Frequency Counter Sensitivity and Trigger Level Tests

For all tests: 1) Waveform = Triangle
2) Frequency = 100 Hz

STEP	RANGE	AMPLITUDE (PEAK-PEAK)	OFFSET	MEASUREMENT MODE	UPPER LIMIT	LOWER LIMIT
1	400 mV ac	425 mV	0	Duty Cycle	54%	46%
2	4V ac	848 mV	0	Duty Cycle	66%	32%
3	4V dc	3.40V	1.70V	Duty Cycle	64%	36%
4	40V dc	7.00V	4.00V	Duty Cycle	93%	7%

Table 3-6. DC Voltage Test

STEP	DC INPUT VOLTAGE	DISPLAY READING		
		83	85	87
1	3.500V	3.488 to 3.512	3.495 to 3.505	3.495 to 3.505
2	35.00V	34.88 to 35.12	34.95 to 35.05	34.95 to 35.05
3	-35.00V	-34.88 to -35.12	-34.95 to -35.05	-34.95 to -35.05
4	350.0V	348.8 to 351.2	349.5 to 350.5	349.5 to 350.5
5	1000V	996 to 1004	998 to 1002	998 to 1002

3-21. 1-MS MIN MAX Test (Model 87 only)

The following procedure checks the minimum/maximum hold feature of the Model 87 Multimeter.

1. Apply 2.0V ac at 60 Hz (step 1, Table 3-7) from the Calibrator to the VΩ→⊢ and COM inputs of the Multimeter. Prior to entering the MIN MAX mode, rotate the function selector knob to either dc volts (for dc coupling of the input) or ac volts (for capacitive coupling of the input).

NOTE

The rms converter is not used in Peak mode. The digital display represents the actual peak value of the input.

2. Press the MIN MAX button to enter the Min/Max mode.
3. Press the beeper button to both enter the 1-millisecond mode and begin display of maximum values.
4. Check for the maximum reading called for in step 1 of Table 3-7.
5. Press the MIN MAX button to begin display of minimum values.
6. Check for the minimum reading called for in step 2 of Table 3-7.

3-22. mV DC Tests

The following test verifies accuracy in the dc millivolt ranges.

1. Connect the Calibrator to the VΩ→⊢ and COM inputs on the Multimeter.
2. Set the Multimeter to the mV⎓ function.
3. Apply 350.0 mV and check for the appropriate multimeter display, as follows:

Model 83	348.8 to 351.2
Model 85	349.5 to 350.5
Model 87	349.5 to 350.5

3-23. Ohms Tests

Use the following procedure to verify resistance measurement accuracy.

1. Connect the Resistance Calibrator to VΩ→⊢ and COM on the Multimeter.
2. Rotate the multimeter function selector to Ω.
3. Check for the required display for each input called for in steps 1 through 4 of Table 3-8.
4. Press the RANGE button on the Multimeter to enter the 40-nanosiemen range, used for conductance tests of high resistances. Then proceed with step 5 of Table 3-8.

3-24. Capacitance Tests

The Multimeter measures capacitance by charging the capacitor with a known direct current, measuring the resultant voltage, and calculating the capacitance. If the same capacitance is measured on an impedance bridge, a different reading may result. This variance is likely to be greater at higher frequencies.

Table 3-7. 1-MS MIN MAX Test

STEP	AC INPUT		DISPLAY READING		
	VOLTAGE	FREQUENCY	83	85	87
1	2.0V	60 Hz	n/a	n/a	2.783 to 2.873
2	2.0V	60 Hz	n/a	n/a	-2.783 to -2.873

Table 3-8. Ohms Tests

STEP	RESISTANCE	DISPLAY READING		
		83	85	87
1	190.0Ω	189.1 to 190.9	189.5 to 190.5	189.5 to 190.5
2	19.00 kΩ	18.91 to 19.09	18.95 to 19.05	18.95 to 19.05
3	1.900 MΩ	1.891 to 1.909	1.895 to 1.905	1.895 to 1.905
4	19.00 MΩ	18.78 to 19.22	18.78 to 19.22	18.78 to 19.22
5	100.0 MΩ	9.80 to 10.20	40M 9.80 to 10.20 MAX	9.80 to 10.20

The following procedure verifies the capacitance measuring accuracy of your Multimeter.

1. Connect the Precision Decade Capacitor to the VΩ⊣◀ and COM inputs on the Multimeter.

2. For steps 1 through 3 in Table 3-9, turn the rotary switch to))) Ω ⊣(, press the blue button, connect the test leads to the capacitor, and check for the appropriate display on your Multimeter. The meter selects the proper range automatically. Each measurement takes about one second per range.

3. For step 4, first use the Relative mode (REL) to zero the display and automatically subtract the residual meter and test lead capacitance. Note that the Relative mode puts the multimeter into manual ranging.

3-25. Diode Test

Use the following procedure to check the diode function:

1. Rotate the multimeter function selector to ⊣◀.

2. Connect the Calibrator to the VΩ⊣◀ and COM inputs on the Multimeter.

NOTE

On Fluke 5100 series calibrators, activate the 50Ω divider override.

3. Apply 3.000V, and look for a display response of 3.000 ± 0.061V dc.

3-26. mA Tests

The following procedure verifies accuracy of both ac and dc current measurement when the multimeter function selector is set to **mA/A** ⎓ ∿.

1. Connect the Calibrator to the mA μA and COM inputs on the Multimeter.

2. Set the multimeter function to **mA/A** ⎓ ∿.

3. Perform steps 1 and 2 in Table 3-10, checking for the appropriate multimeter display for each input.

4. Press the blue button on the Multimeter to toggle to ac current measurement.

5. Perform steps 3 through 6 in Table 3-10, checking for the appropriate multimeter display for each input.

Table 3-9. Capacitance Tests

STEP	CAPACITANCE	DISPLAY READING		
		83	85	87
1	1.0 μF	0.97 to 1.03	0.97 to 1.03	0.97 to 1.03
2	0.470 μF	0.463 to 0.477	0.463 to 0.477	0.463 to 0.477
3	0.0470 μF	0.0463 to 0.0477	0.0463 to 0.0477	0.0463 to 0.0477
4	4.70 nF	4.63 to 4.77	4.63 to 4.77	4.63 to 4.77

Table 3-10. mA Tests

STEP	DC CURRENT		DISPLAY READING		
			83	85	87
1	35.00 mA		34.84 to 35.16	34.91 to 35.09	34.91 to 35.09
2	350.0 mA		348.4 to 351.6	349.1 to 350.9	349.1 to 350.9
	AC CURRENT	**FREQ**	**83**	**85**	**87**
3	35.00 mA	60 Hz	34.56 to 35.44	34.77 to 35.23	34.63 to 35.37
4	35.00 mA	1.0 kHz	34.56 to 35.44	34.77 to 35.23	34.63 to 35.37
5	350.0 mA	60 Hz	345.6 to 354.4	347.7 to 352.3	346.3 to 353.7
6	350.0 mA	1.0 kHz	345.6 to 354.4	347.7 to 352.3	346.3 to 353.7

3-27. μA Tests

The following test verifies accuracy in the microamp (μA) measurement mode.

1. Connect the Calibrator to the mA μA and COM inputs on the Multimeter.
2. Rotate the multimeter function selector to μA ⎓~.
3. Verify correct display readings for the given dc inputs in steps 1 and 2 of Table 3-11.
4. Press the blue button on the Multimeter to enable ac measurements.
5. Check for the appropriate multimeter readings for steps 3 through 6 of Table 3-11.

3-28. A Tests

Use the following procedure to verify measurement accuracy in the ampere (A) mode.

1. If necessary, set the calibrator output to 0.
2. Rotate the multimeter function selector to mA/A ⎓~.
3. Connect the Calibrator to the A and COM inputs of the Multimeter.
4. Perform steps 1 and 2 in Table 3-12. For each input, check that a display appropriate for your Multimeter is obtained.
5. Set the calibrator output to 0. Now press the blue button on the Multimeter to toggle to ac current measurement once again.
6. Perform steps 3 through 6 in Table 3-12.

3-29. CALIBRATION

Calibrate the meter once a year to ensure that it performs according to specifications. Connect the Calibrator to the VΩ→⊢ and COM inputs on the Multimeter. Calibration adjustment points are identified in Figure 3-4. The slightly different routines required for each model of the 80 Series are presented in the following paragraphs.

3-30. Models 83 and 85 Calibration

Calibrate the Fluke 83 or 85 with the following procedure:

1. Set the source for VDC, 0V.
2. On the multimeter, select the V⎓ function.

Table 3-11. μA Tests

STEP	DC CURRENT		DISPLAY READING		
			83	85	87
1	350.0 μA		348.4 to 351.6	349.1 to 350.9	349.1 to 350.9
2	3500 μA		3484 to 3516	3491 to 3509	3491 to 3509
	AC CURRENT	FREQ	83	85	87
3	350.0 μA	60 Hz	345.6 to 354.4	347.7 to 352.3	346.3 to 353.7
4	350.0 μA	1.0 kHz	345.6 to 354.4	347.7 to 352.3	346.3 to 353.7
5	3500 μA	60 Hz	3456 to 3544	3477 to 3523	3463 to 3537
6	3500 μA	1.0 kHz	3456 to 3544	3477 to 3523	3463 to 3537

Table 3-12. A Tests

STEP	DC CURRENT		DISPLAY READING		
			83	85	87
1	3500 mA		3484 to 3516	3491 to 3509	3491 to 3509
2	10.00A		9.94 to 10.06	9.96 to 10.04	9.96 to 10.04
	AC CURRENT	FREQ	83	85	87
3	3500 mA	60 Hz	3456 to 3544	3477 to 3523	3463 to 3537
4	3500 mA	1.0 kHz	3456 to 3544	3477 to 3523	3463 to 3537
5	10.00A	60 Hz	9.86 to 10.14	9.92 to 10.08	9.88 to 10.12
6	10.00A	1.0 kHz	9.86 to 10.14	9.92 to 10.08	9.88 to 10.12

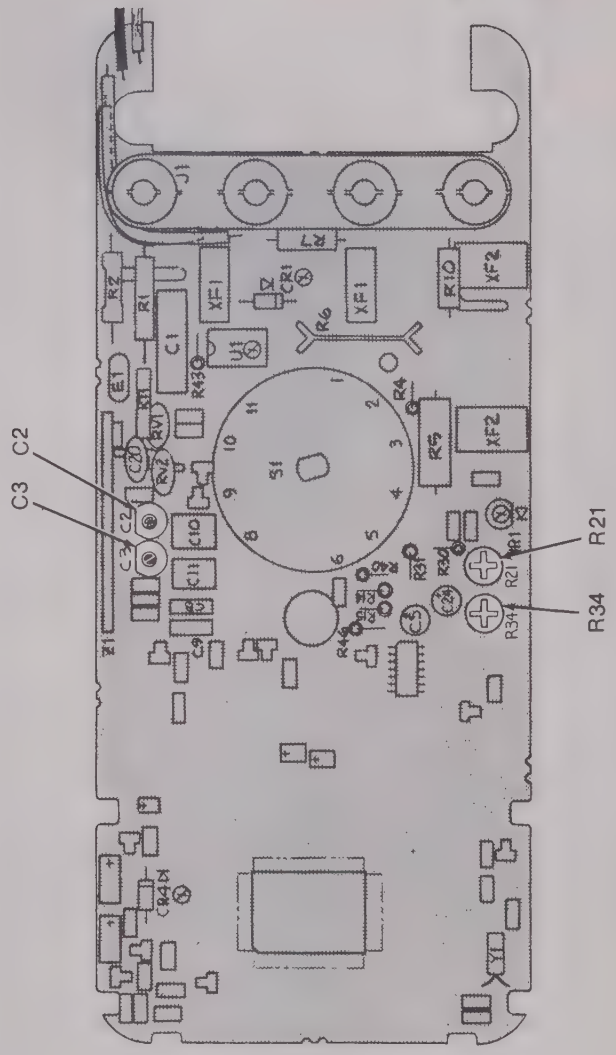

Figure 3-4. Calibration Adjustment Points

3. Connect the source to the VΩ→⊢ and COM inputs on the multimeter.

4. Set the source for 3.500V dc output.

5. The multimeter should now display 3.500 ±0.001. If necessary, adjust R21 to obtain the proper display.

6. Now set the multimeter to the V~ function, then set the source for an output of 3.500V at 100 Hz.

7. The multimeter should now display 3.500 ±0.002. If necessary, adjust R34 to obtain the proper display.

8. Set the source for an output of 3.500V at 10 kHz.

9. The multimeter should now display 3.500 ±0.004. If necessary, adjust C2 to obtain the proper display.

10. Set the source for an output of 35.00V at 10 kHz.

11. The multimeter should now display 35.00 ±0.04. If necessary, adjust C3 to obtain the proper display.

3-31. Model 87 Calibration

Calibrate the Fluke 87 with the following procedure:

1. Set the source for VDC, 0V.

2. On the Model 87, select the V⎓ function.

3. Connect the source to the Model 87 VΩ→⊢ and COM inputs.

4. Set the source for 3.500V dc output.

5. The Model 87 should now display 3.500 ±0.001. If necessary, adjust R21 to obtain the proper display.

6. Now set the Model 87 to the V~ function, then set the source for an output of 3.513V at 50 Hz.

7. The Model 87 should now display 3.500 ±0.002. If necessary, adjust R34 to obtain the proper display.

8. Set the source for an output of 3.500V at 10 kHz.

9. The Model 87 should now display 3.500 ±0.004. If necessary, adjust C2 to obtain the proper display.

10. Set the source for an output of 35.00V at 10 kHz.

11. The Model 87 should now display 35.00 ±0.04. If necessary, adjust C3 to obtain the proper display.

3-32. TROUBLESHOOTING

If the meter fails, check the battery and fuses and replace as needed. If problems persist, verify that you are operating the meter correctly by reviewing the operating instructions found in the User's Manual. If these measures suggest a fault with the multimeter, consult the power supply troubleshooting procedures in this section and the signal flow diagrams in Section 5 of this manual.

3-33. Servicing Surface-Mount Assemblies

The 80 Series multimeters incorporate Surface-Mount Technology (SMT) for printed circuit assemblies (pca's). Surface-mount components are much smaller than their predecessors, with leads soldered directly to the surface of a circuit board; no plated through-holes are used. Unique servicing, troubleshooting, and repair techniques are required to support this technology. The information offered in the following paragraphs serves only as an introduction to SMT. It is not recommended that repair be attempted based only on the information presented here. Refer to the Fluke Surface Mount Device Soldering Kit for a complete demonstration and discussion of these techniques (call 1-800-526-4731 to order).

Since sockets are seldom used with SMT, shotgun troubleshooting cannot be used; a fault should be isolated to the component level before a part is replaced. Surface-mount assemblies are probed from the component side. The special probes make contact only with the pads in front of the component leads. With the close spacing involved, ordinary test probes can easily short two adjacent pins on an SMT IC.

This Service Manual is a vital source for component locations and values. With limited space on the circuit board, chip component locations are seldom labeled. Figures provided in Section 4 of this manual provide this information. Also, remember that chip components are not individually labeled; keep any new or removed component in a labeled package.

Surface-mount components are removed and replaced by reflowing all the solder connections at the same time. Special considerations are required.

Table 3-13. Functional Description of Power Supply Components

COMPONENT	FUNCTION
R24, R25	Vdd Regulator series regulator device
Q8	Power on/off device
Q10	Power supply startup device. Q10 provides Q3 base startup current. Q10 is always off during meter operation.
CR5	CR5 is in the power supply series loop, allowing for generation of Vbt=+3.6V for diode test.
VR1	VR1 provides the system reference voltage. It is used for the A/D Converter reference and as a reference for both power supply regulators.
C14	Vdd regulator compensation and bypass.
C21	Common regulator compensation and bypass.
C35	Battery and CR5 bypass.
C32	Q8 gate bypass.
R24, R25	Vdd regulator voltage sensing resistors.
R37, R38	Common regulator voltage sensing resistors.
R44	Supplies bias current to VR1.
R54	Q8 gate pull-up resistor.

- The solder tool uses regulated hot air to melt the solder; there is no direct contact between the tool and the component.

- Surface-mount assemblies require rework with wire solder rather than with solder paste. A 0.025 inch diameter wire solder composed of 63% tin and 37% lead is recommended. A 60/40 solder is also acceptable.

- A good connection with SMT requires only enough solder to make a positive metallic contact. Too much solder causes bridging, while too little solder can cause weak or open solder joints. With SMT, the anchoring effect of the through-holes is missing; solder provides the only means of mechanical fastening. Therefore, the pca must be especially clean to ensure a strong connection. An oxidized pca pad causes the solder to wick up the component lead, leaving little solder on the pad itself.

Refer to the Fluke Surface Mount Device Soldering Kit for a complete discussion of these techniques.

3-34. TROUBLESHOOTING - POWER SUPPLY

The two regulator circuits are interrelated; a malfunction in either the common regulator or the Vdd regulator may cause a problem in the other. Refer to Tables 3-13 and 3-14 for descriptions of power supply components and voltage levels, respectively. To isolate the problem regulator circuit, disconnect the battery, and drive Vdd - Vss = 6.2V with a power supply. This procedure tests the common regulator independently of the Vdd regulator.

Table 3-14. Voltage Levels

VDD	3.0 ±0.3
VSS	-3.2 ±0.3
VBT+	3.5 ±0.3
VBT-	-5.5 (battery at full 9V charge) -3.0 (battery at low charge of 6.5V)
REFH	1.235 ±0.012
PS0	1.235 ±0.15
PS1	0 ±0.15
AP6	-0.5 to -0.15
VOA	2.2 to 1.7 (referenced from VSS)
VOB	1.07 to .91 (referenced from VSS)

Now check for Vdgnd - Vss = -3.2V ±0.3V. If this test is successful, the problem lies with the Vdd regulator; refer to Vdd Regulator Troubleshooting later in this section. If this test is not successful, the problem lies with the common regulator; continue with the Common Regulator Troubleshooting below.

Note that if the common regulator works or has been repaired, check both supplies with the 9V battery supply.

3-35. Common (Shunt) Regulator Troubleshooting

To troubleshoot the common regulator, connect the power supply so that Vdd, Vss, and DGND (digital ground) are supplied from an external power supply. This procedure over-drives the large on-chip shunt transistors; the bias current from the power supply ranges from 10 mA to 100 mA. Refer to Figure 3-5 for a simplified diagram of the common regulator. Make the following tests:

1. Check for +1.235V ±20 mV (Vrefh) at the cathode of VR1. If Vrefh is not correct, check VR1, R19, R20, and R44 and the traces to these parts carefully. If Vrefh is still incorrect, U4 is bad.

2. If Vrefh is correct, measure the voltage at U4 pin 6 (PS1). If Vps1 is not equal to 0V ±0.15V, check R37 and R38 and their associated traces. If Vps1 is still at an incorrect voltage, U4 is bad.

3. A DGND and Vss current much larger than 100 mA may indicate a problem with Q12 (Vdgnd-to -Vss quick turn-off clamp) or its base drive signal from U6. The Q12 clamp is off when the instrument is on and on when the instrument is off.

4. Check the bias generator circuit. With the exception of resistor R35 (620 kΩ), the bias generator (which sets the bias level for all U4 analog circuitry) is internal to U4. A problem with this circuit could cause the on-chip power supply op amps to not work. Measure the dc voltage between U4 pin 8 (Vbias) and DGND. If -0.2V < Vbias > +0.2V the bias generator is okay. If Vbias is not correct, check R35. If Vbias is still wrong, replace U4.

5. Measure the ac voltage between Vdgnd and Vss. If it is greater than 10 mV ac, check C21. (An open C21 causes common regulator instability.) The dc level may also be incorrect.

6. If the common regulator still does not work, circuitry internal to U4 is bad. Replace U4.

3-36. Vdd (Series) Regulator Troubleshooting

If a problem still exists after the common regulator troubleshooting, continue on with the following Vdd regulator troubleshooting. Often, a short or sneak current path causes power supply problems. Refer to Figure 3-5 for a simplified diagram of the Vdd (Series) Regulator. Make the following tests:

1. Measure the dc operating current from the 9V battery. If it is greater than 1.2 mA for an 83/85 or greater than 1.4 mA for an 87, a sneak current path exists. A sneak current path can be very difficult to find.

2. First, visually check for both solder bridges on U4 pins and other circuit board shorts.

Isolate the current path at the negative battery terminal (Vbt-). The components connected to Vbt- are C35, CR4, R56, U6, Q8, and the rotary knob fingers. Remove these parts one at a time (except Q8). Measure I(bat) after each removal to isolate the problem.

1. If the excess battery current stops after removing R56, either R56, R57, Q9, or Q11 may be bad. If one of these four parts is bad a problem may not be noticed until U6 is removed.

2. If the extra current is still present with all parts except Q8 removed, remove Q10 and check for excess battery current. If I(bat) is now correct, Q10 is bad. If I(bat) is still excessive, U4 is probably at fault.

If the power supply is not working, but battery current is normal, perform the following tests.

1. With the 9V battery attached, cycle the unit off and on. If both supplies are less than 1.0V, a problem probably exists with the on/off circuit. Check Q8, R54, and C32.

2. Check the rotary knob wiper contacts; verify that the Q8 gate voltage is close to Vbt+.

3. If Vdd - Vss is low, a problem may exist with start up device Q10. Check Q10 by momentarily connecting Vss to Vbt-. If both Vss and Vbt- now start up and operate correctly, check Q10 for an open.

4. Measure the ac voltage between Vdd and Vss. An unstable Vdd regulator can be caused by an open C14. If it is greater than 10 mV ac, check C14. The dc level may also be incorrect.

For a final check of U4, remove the battery and supply Vdd = +3.0V, Vdgnd = 0, and Vss = -3.2V from an external power supply. Measure the voltage at U4 pin 7 (Vps0). If it does not equal 1.235V ±0.15V then check R24 and R25 carefully. If Vps0 is still incorrect, U4 is bad.

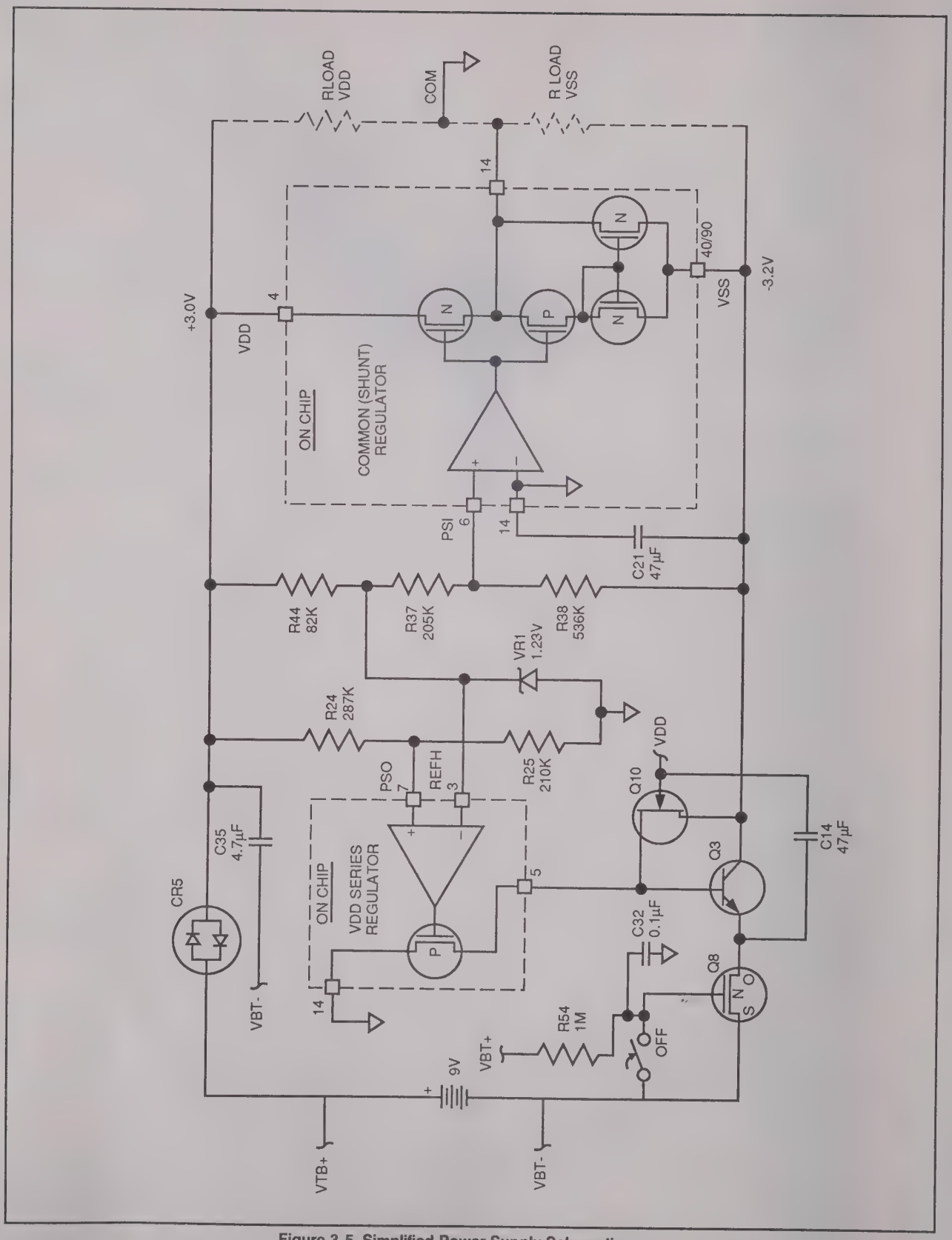

Figure 3-5. Simplified Power Supply Schematic

Section 4
List of Replaceable Parts

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ASSEMBLY NAME	DRAWING NO.	TABLE NO.	TABLE PAGE	FIGURE NO.	FIGURE PAGE
Fluke 83 Final Assembly	Fluke 83 T/B	4-1	4-4	4-1	4-5
Fluke 83 A1 Main PCA	Fluke 83-4001	4-2	4-6	4-2	4-8
Fluke 85 Final Assembly	Fluke 85 T/B	4-3	4-10	4-3	4-11
Fluke 85 A1 Main PCA	Fluke 85-4001	4-4	4-12	4-4	4-14
Fluke 87 Final Assembly	Fluke 87 T/B	4-5	4-16	4-5	4-17
Fluke 87 A1 Main PCA	Fluke 87-4001	4-6	4-18	4-6	4-20

4-1. INTRODUCTION

Section 4 provides illustrated parts lists for the 80 Series Multimeters. A separate list is provided for each model (83, 85, and 87).

Parts are listed alphanumerically by assembly and reference designator. Each part is shown in an accompanying illustration.

The parts lists provide the following information for each part:

- Reference designator
- Description
- Fluke stock number
- Federal supply code for manufacturers
- Manufacturers' part number
- Total quantity of components per assembly
- Recommended quantity

The recommended quantity is the recommended number of spare parts necessary to support one to five instruments for a period of 2 years. This list presumes an availability of common electronics parts at the maintenance site. For maintenance of 1 year or more at an isolated site, it is recommended that at least one of each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc, that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended spares quantity for the sites in that particular assembly.

4-2. HOW TO OBTAIN PARTS

All components may be ordered from the John Fluke Mfg. Co., Inc. or an authorized representative using the FLUKE STOCK NUMBER. In the U.S., order directly from the Fluke Parts Dept. by calling 1-800-526-4731.

Some components may be ordered directly from the manufacturer using the manufacturer's part number.

In the event that the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

To ensure prompt and efficient handling of your order, include the following information.

1. Instrument Model and Serial Number
2. Fluke Stock Number
3. Reference Designator
4. Printed circuit assembly (pca) part number and revision letters
5. Description
6. Quantity

Price information for parts is available from the John Fluke Mfg. Co., Inc., and its authorized representatives. Prices are also available in a Fluke Replacement Parts Catalog, which is available on request.

CAUTION

An asterisk (*) indicates a device that may be damaged by static discharge.

Refer to the end of this section for a list of U. S. and international sales areas for Fluke products and a list of technical service centers.

4-4. MANUAL STATUS INFORMATION

This section contains information necessary to backdate the manual to conform with earlier pca configurations. To identify the configuration of the pca's used in your instrument, refer to the revision letter (marked in ink) on the component side of each pca assembly. Tables 4-7 through 4-9 define assembly revision levels documented in this manual for Models 83, 85, and 87, respectively.

4-5. NEWER INSTRUMENTS

As changes and improvements are made to the instrument, they are identified by incrementing the revision letter marked on the affected pca assembly. These changes are documented on a supplemental change/errata sheet which, when applicable, is inserted at the front of the manual.

Table 4-1. Fluke 83 Final Assembly
(See Figure 4-1.)

REFERENCE DESIGNATOR -A>-NUMERICS---->	S	DESCRIPTION	FLUKE STOCK --NO--	MFRS SPLY -CODE-	MANUFACTURERS PART NUMBER -OR GENERIC TYPE-----	TOT QTY-	R S -Q	N O T -E-
A 1	*	MAIN PCA	819284	89536	819284	1		
BT 1		BATTERY,9V,0-15MA	696534	77542	D1604	1	1	
E 1		CONTACT,PTF	822676	89536	822676	1	1	
E 2		CONTACT,ANNUNCIATOR	822791	89536	822791	1		
F 1		FUSE,.406X1.375,1A,600V,FAST	830828	71400	BBS-1	1	5	
F 2		FUSE,.406X1.5,15A,600V,FAST	820829	71400	KLK-15	1	5	
H 1		SCREW,THD FORM,PH,P,STL,4-14X0.562	832220	89536	832220	1		
H 2		SCREW,THD FORM,PH,P,STL,5-14X0.750	832246	89536	832246	3		
J 1, 2		CONN,ELASTOMERIC,LCD TO PWB,1.540 L	817460	89536	817460	2	1	
MP 1		MASK,LCD	822684	89536	822684	1		
MP 2		SHIELD,TOP	824516	89536	824516	1		
MP 3		SHAFT,SWITCH	822635	89536	822635	1		
MP 4		SHIELD,BOTTOM	824524	89536	824524	1		
MP 5		CASE,TOP & WINDOW ASSEMBLY	828657	89536	828657	1		1
MP 6		CASE,BOTTOM	819250	89536	819250	1		
MP 8		KNOB,SWITCH (PAD XFER)	857271	89536	857271	1		
MP 9		SPRING,DETENT	822643	89536	822643	1	1	
MP 10		FOOT,NON SKID	824466	89536	824466	3		
MP 12		GASKET,CASE	826198	89536	826198	1	1	
MP 13		SHOCK ABSORBER	828541	89536	828541	1		
MP 14		O-RING,SYN RUBBER,1.670 ID,0.047 WIDE	831933	89536	831933	1	1	
MP 15		HOLSTER&FLEXSTAND ASSY (YELLOW)	822809	89536	822809	1		
MP 19		TEST LEADS	642033	89536	642033	1		
MP 21		FOOT,ADHESIVE,RUBBER,GREY,.50X.23	853924	89536	853924	1		
S 1		SWITCH PAD, MOMENTARY	809988	89536	809988	1		
TM 5		83/85 USER'S MANUAL (ENGLISH)	852426	89536	852426	1		
TM 6		83/85 USER'S MANUAL (INTERNATIONAL)	852434	89536	852434	1		
U 5		LCD,4.5 DIGIT,BAR GRAPH,MULTIPLEXED	782763	89536	782763	1	1	

An * in 'S' column indicates a static-sensitive part.

NOTE 1 = MP5 includes MP8 and MP9.

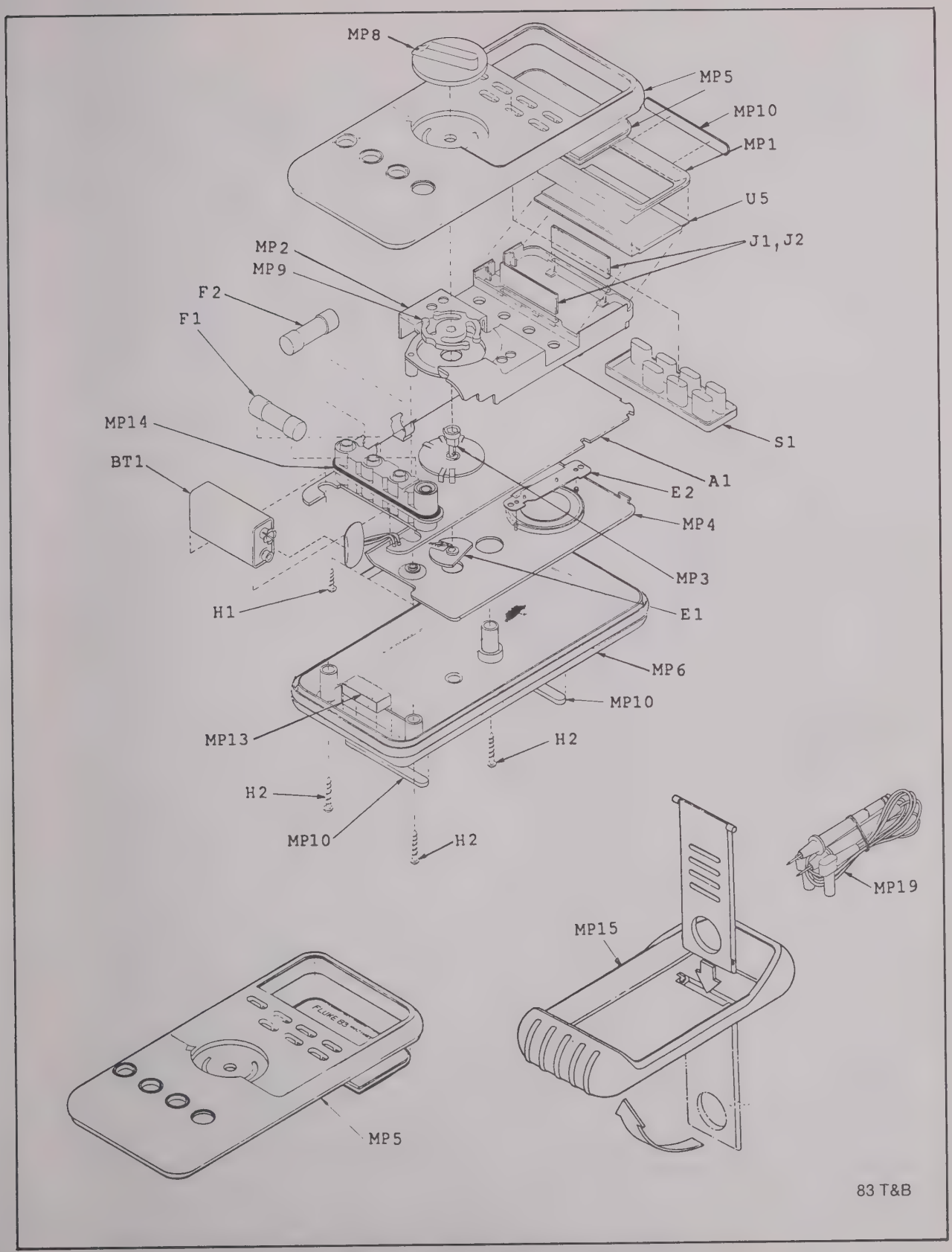

Figure 4-1. Fluke 83 Final Assembly

Table 4-2. A1 Main PCA
(See Figure 4-2.)

REFERENCE DESIGNATOR -A>-NUMERICS---->	S	DESCRIPTION	FLUKE STOCK --NO--	MFRS SPLY -CODE-	MANUFACTURERS PART NUMBER -OR GENERIC TYPE-----	TOT QTY-	R S -Q	N O T -E-
C 1		CAP,POLYES,0.01UF,+-10%,1000V	822361	89536	822361	1		
C 2		CAP,VAR,3-11PF,100V,CER	641712	89536	641712	1		
C 3		CAP,VAR,9-90PF,50V,CER	643130	89536	643130	1		
C 4		CAP,CER,430PF,+-2%,50V,C0G,1206	851816	89536	851816	1		
C 5		CAP,TA,15UF,+-20%,6.3V	807636	56289	199D156X06R3BA1	1		
C 8, 9		CAP,POLYCA,0.027UF,+-10%,63V	720979	89536	720979	2		
C 10		CAP,POLYES,0.47UF,+-10%,50V	697409	84411	J1320R47MF10PCT50V	1		
C 11		CAP,POLYPR,0.022UF,+-10%,63V	821579	89536	821579	1		
C 14, 21		CAP,TA,47UF,+-20%,10V	746990	89536	746990	2		
C 15, 16, 32		CAP,CER,0.1UF,+-10%,25V,X7R,1206	747287	89536	747287	3		
C 17, 18		CAP,CER,22PF,+-10%,50V,C0G,1206	740563	89536	740563	2		
C 19		CAP,CER,8.2PF,+-10%,50V,C0G,1206	747303	89536	747303	1		
C 20		CAP,CER,5.6PF,+-0.25PF,1500V,C0H	851811	89536	851811	1		
C 22		CAP,CER,1000PF,+-10%,50V,C0G,1206	747378	89536	747378	1		
C 24		CAP,TA,10UF,+-20%,10V	714766	56289	199D106X0010BA1	1		
C 27		CAP,CER,100PF,+-10%,50V,C0G,1206	740571	89536	740571	1		
C 28, 29		CAP,TA,0.47UF,+-20%,50V	807990	89536	807990	2		
C 30		CAP,CER,220PF,+-10%,50V,C0G,1206	758078	89536	758078	1		
C 31, 33, 34		CAP,CER,0.01UF,+-10%,50V,X7R,1206	747261	89536	747261	3		
C 35		CAP,TA,4.7UF,+-20%,15V	745976	89536	745976	1		
C 36		CAP,CER,68PF,+-10%,50V,C0G,1206	853861	89536	853861	1		
CR 1, 4		DIODE,SI,1K PIV,1.0 AMP	707075	04713	SR4348RL	2	1	
CR 5, 7, 8	*	DIODE,SI,BV=70.0V,IO=50MA,DUAL,SOT23	742320	89536	742320	3	1	
E 1		SURGE PROTECTOR,1500V,+-20%	655134	89536	655134	1		
J 1		INPUT RCPT ASSY	826214	89536	826214	1		
Q 1, 2, 6	*	TRANSISTOR,SI,NPN,SELECTED IEBO,SOT23	821637	89536	821637	3	1	
Q 3, 9, 12	*	TRANSISTOR,SI,NPN,SMALL SIGNAL,SOT23	742676	89536	742676	3	1	
Q 8	*	TRANSISTOR,SI,N-DMOS FET,SOT23	830851	89536	830851	1	1	
Q 10	*	TRANSISTOR,SI,P-CHAN,SOT-23	832477	89536	832477	1	1	
Q 11	*	TRANSISTOR,SI,PNP,SMALL SIGNAL,SOT23	742684	89536	742684	1	1	
R 1		RES,MF,1K,+-1%,100PPM,FLMPRF,FUSIBLE	832550	89536	832550	1	1	
R 2	*	RES,TINOX,909K,+-1%,2W	831594	89536	831594	1		
R 3	*	RES,CERM,1.5K,+-5%,.125W,250PPM,1206	746438	89536	746438	1		
R 4		RES,MF,110.1,+-0.1%,0.125W,100PPM	821728	89536	821728	1		
R 5		RES,WW,0.991,+-0.1%,2.5W	821645	89536	821645	1		
R 6		RES,WW,0.010,+-0.1%,1W,100PPM	807305	89536	807305	1		
R 7, 10	*	RES,CERM,1M,+-5%,1W	655175	89536	655175	2		
R 8, 48	*	RES,CERM,15M,+-5%,.125W,300PPM,1206	811968	89536	811968	2		
R 9, 13, 29	*	RES,CERM,100K,+-5%,.125W,250PPM,1206	740548	89536	740548	3		
R 11	*	RES,CERM,10M,+-5%,.125W,250PPM,1206	783274	89536	783274	1		
R 12	*	RES,CERM,10K,+-5%,.125W,250PPM,1206	746610	89536	746610	1		
R 14		RES,MF,10K,+-0.1%,0.125W,100PPM	658955	89536	658955	1		
R 15		RES,MF,90K,+-0.1%,0.125W,100PPM	658906	89536	658906	1		
R 17, 18, 42,	*	RES,CERM,1M,+-5%,.125W,250PPM,1206	746826	89536	746826	4		
R 54	*		746826					
R 19	*	RES,CERM,56.2K,+-1%,.125W,100PPM,1206	831305	89536	831305	1		
R 20, 37	*	RES,CERM,205K,+-1%,.125W,100PPM,1206	769836	89536	769836	2		
R 21		RES,VAR,CERM,100K,+-20%,0.3W	649897	89536	649897	1		
R 24	*	RES,CERM,287K,+-1%,0.125W,100PPM,1206	853895	89536	853895	1		
R 25	*	RES,CERM,210K,+-1%,.125W,100PPM,1206	821660	89536	821660	1		
R 28	*	RES,CERM,84.5K,+-1%,.125W,100PPM,1206	853510	89536	853510	1		
R 30		RES,MF,20K,+-0.25%,0.125W,50PPM	715029	59124	MFF1-82002C	1		
R 31, 40		RES,MF,22.6K,+-0.25%,0.125W,50PPM	715011	59124	MFF1-82262C	2		
R 34		RES,VAR,CERM,1K,+-20%,0.3W	831420	89536	831420	1		
R 35	*	RES,CERM,620K,+-5%,.125W,250PPM,1206	811919	89536	811919	1		
R 38, 60	*	RES,CERM,536K,+-1%,.125W,100PPM,1206	845420	89536	845420	2		
R 41, 47	*	RES,CERM,0.05MAX,.125W,1206	810747	89536	810747	2		
R 43		RES,MF,1K,+-0.1%,0.125W,100PPM	821694	89536	821694	1		
R 44	*	RES,CERM,82K,+-5%,.125W,250PPM,1206	811794	89536	811794	1		
R 46		RES JUMPER,0.02,0.25W	682575	89536	682575	1		
R 56, 57	*	RES,CERM,22K,+-5%,.125W,250PPM,1206	746651	89536	746651	2		
R 58	*	RES,CERM,120K,+-5%,.125W,250PPM,1206	746719	89536	746719	1		
R 59	*	RES,CERM,510,+-5%,.125W,250PPM,1206	746388	89536	746388	1		
RT 1		THERMISTOR,RECT,POS,1.5K,+-30%,25 C	822015	89536	822015	1	1	
RV 1, 2		VARISTOR,910V,+-10%,1.0MA	817106	89536	817106	2	1	
S 1		SWITCH,ROTARY	819334	89536	819334	1		
U 1		DIODE,SI,RECT,BRIDGE,BV=50V,IO=1.0A	418582	14936	DF005	1		
U 4	*	IC CMOS OLYMPUS, ASSEMBLY TESTED	809301	89536	809301	1	1	
U 6	*	IC,CMOS,HEX INVERTER,SOIC	838375	89536	838375	1	1	

An * in 'S' column indicates a static-sensitive part.

Table 4-2. A1 Main PCA (cont.)

REFERENCE DESIGNATOR -A->-NUMERICS---->	S	DESCRIPTION	FLUKE STOCK --NO--	MFRS SPLY -CODE-	MANUFACTURERS PART NUMBER -OR GENERIC TYPE-----	TOT QTY-	RS -Q	NOT -E-
VR 1	*	BANDGAP,TAPED	729202	89536	729202	1	1	
W 1		JUMPER WIRE NEG	834994	89536	834994	1		
W 2		JUMPER WIRE,POS	835009	89536	835009	1		
XBT 1		CONNECTOR,BATTERY	825976	89536	825976	1		
XF 1		CONTACT,600V,FUSE	659524	89536	659524	2		1
XF 2		600 VOLT FUSE CONTACT	707190	89536	707190	2		2
Y 1		CRYSTAL,131.072KHZ,0.003%,3X8MM	831453	89536	831453	1	1	
Z 1		RES NET THK FILM TESTED	828152	89536	828152	1		

An * in 'S' column indicates a static-sensitive part.

NOTE 1 = Ref. Designator XF1 is two (2) parts. They are used with F1 on the Final Assembly.

NOTE 2 = Ref. Designator XF2 is two (2) parts. They are used with F2 on the Final Assembly.

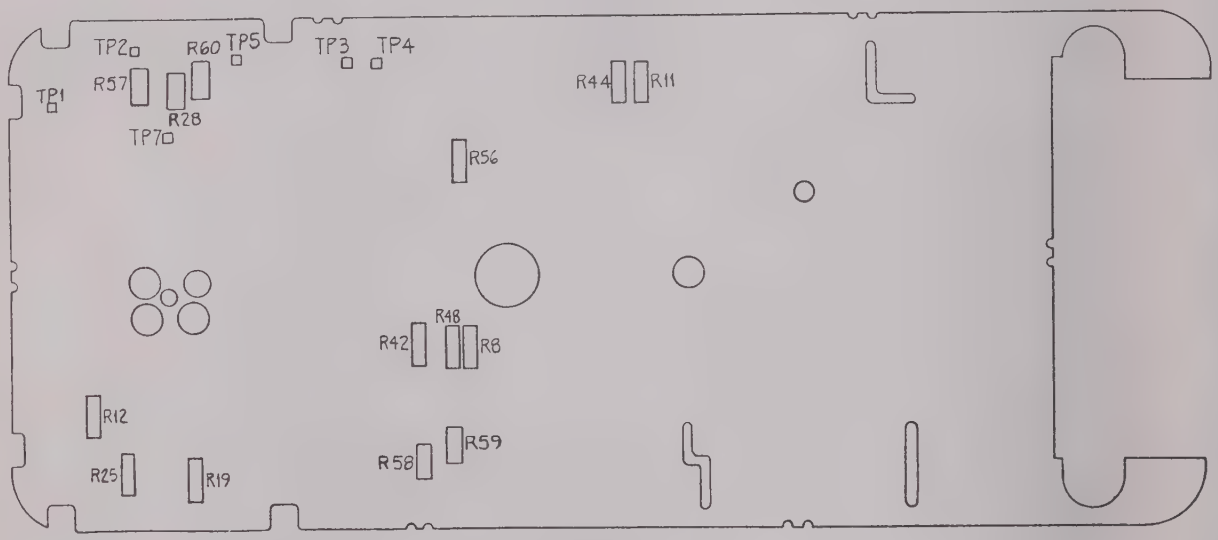

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Figure 4-2. Fluke 83 A1 Main PCA

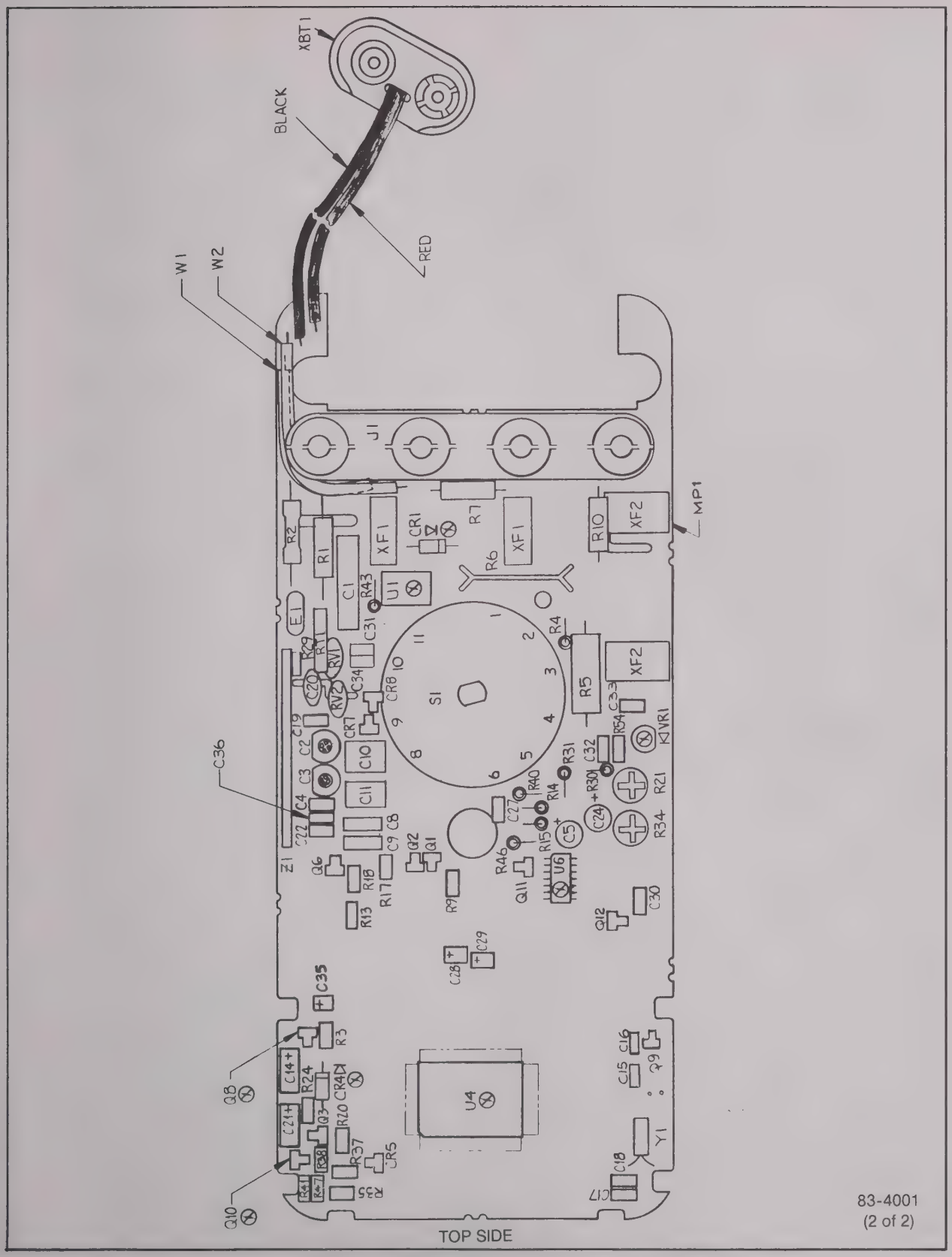


Figure 4-2. Fluke 83 A1 Main PCA (cont)

Table 4-3. Fluke 85 Final Assembly
(See Figure 4-3.)

REFERENCE DESIGNATOR -A>-NUMERICS---->	S	DESCRIPTION	FLUKE STOCK --NO--	MFRS SPLY -CODE-	MANUFACTURERS PART NUMBER -OR GENERIC TYPE-----	TOT QTY-	R S -Q	N O T -E-
A 1	*	MAIN PCA	819276	89536	819276	1		
BT 1		BATTERY,9V,0-15MA	696534	77542	D1604	1	1	
E 1		CONTACT,PTF	822676	89536	822676	1	1	
E 2		CONTACT,ANNUNCIATOR	822791	89536	822791	1		
F 1		FUSE,.406X1.375,1A,600V,FAST	830828	71400	BBS-1	1	5	
F 2		FUSE,.406X1.5,15A,600V,FAST	820829	71400	KLK-15	1	5	
H 1		SCREW,THD FORM,PH,P,STL,4-14X0.562	832220	89536	832220	1		
H 2		SCREW,THD FORM,PH,P,STL,5-14X0.750	832246	89536	832246	3		
J 1		CONN,ELASTOMERIC,LCD TO PWB,1.540 L	817460	89536	817460	2	1	
MP 1		MASK,LCD	822684	89536	822684	1		
MP 2		SHIELD,TOP	824516	89536	824516	1		
MP 3		SHAFT,SWITCH	822635	89536	822635	1		
MP 4		SHIELD,BOTTOM	824524	89536	824524	1		
MP 5		CASE,TOP & WINDOW ASSEMBLY	824540	89536	824540	1		1
MP 6		CASE,BOTTOM	819250	89536	819250	1		
MP 8		KNOB,SWITCH (PAD XFER)	857271	89536	857271	1		
MP 9		SPRING,DETENT	822643	89536	822643	1	1	
MP 10		FOOT,NON SKID	824466	89536	824466	3		
MP 12		GASKET,CASE	826198	89536	826198	1	1	
MP 13		SHOCK ABSORBER	828541	89536	828541	1		
MP 14		O-RING,SYN RUBBER,1.670 ID,0.047 WIDE	831933	89536	831933	1	1	
MP 15		HOLSTER&FLEXSTAND ASSY (YELLOW)	822809	89536	822809	1		
MP 19		TEST LEADS	642033	89536	642033	1		
MP 21		FOOT,ADHESIVE,RUBBER,GREY,.50X.23	853924	89536	853924	1		
S 1		SWITCH PAD, MOMENTARY	809988	89536	809988	1		
TM 5		83/85 USER'S MANUAL (ENGLISH)	852426	89536	852426	1		
TM 6		83/85 USER'S MANUAL (INTERNATIONAL)	852434	89536	852434	1		
U 5		LCD,4.5 DIGIT,BAR GRAPH,MULTIPLEXED	782763	89536	782763	1	1	

An * in 'S' column indicates a static-sensitive part.

NOTE 1 = MP5 includes MP8 and MP9.

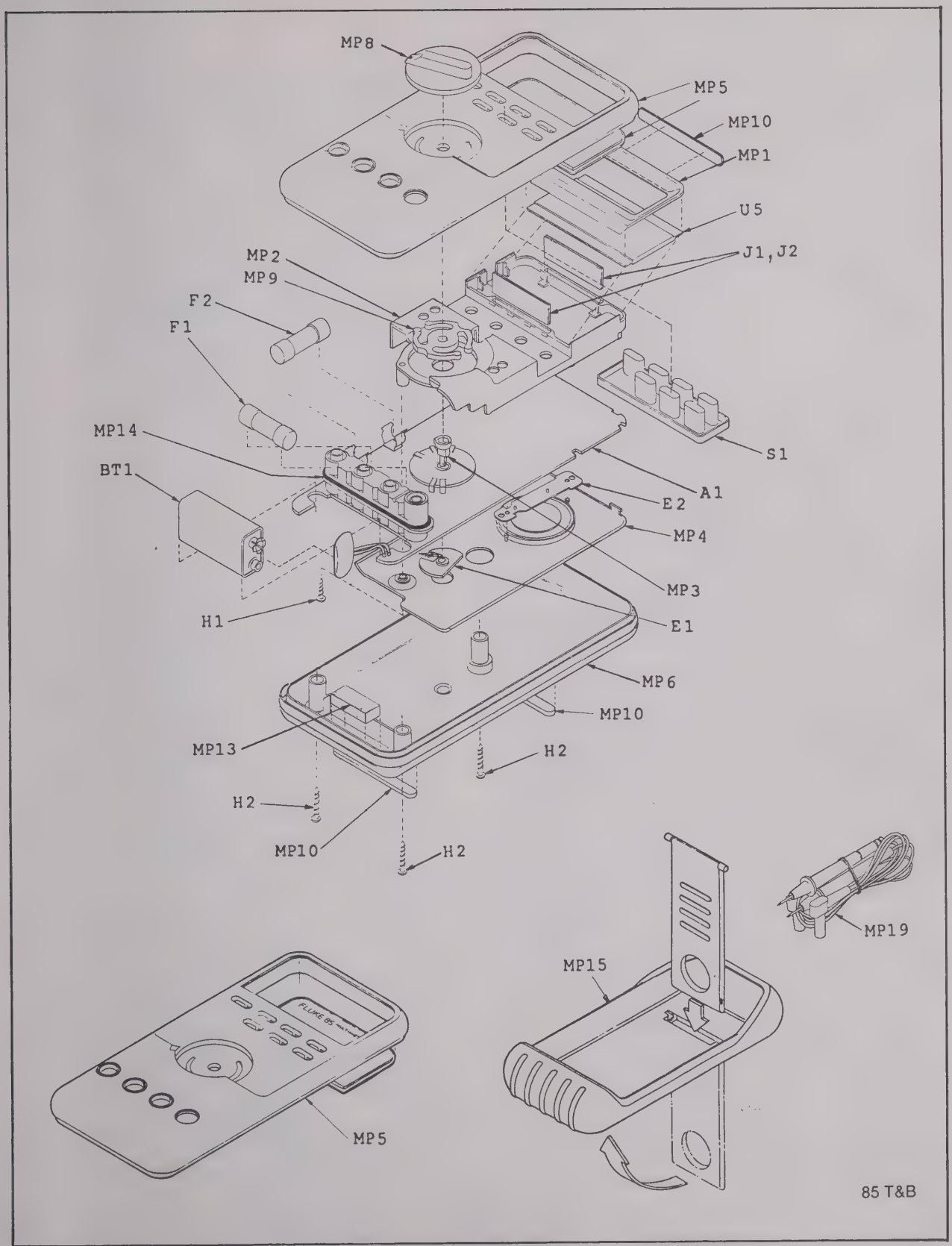


Figure 4-3. Fluke 85 Final Assembly

Table 4-4. A1 Main PCA
(See Figure 4-4.)

REFERENCE DESIGNATOR -A>-NUMERICS---->	S	DESCRIPTION	FLUKE STOCK --NO--	MFRS SPLY -CODE-	MANUFACTURERS PART NUMBER -OR GENERIC TYPE-----	TOT QTY-	R S -Q	N O T -E-
C 1		CAP,POLYES,0.01UF,+-10%,1000V	822361	89536	822361	1		
C 2		CAP,VAR,3-11PF,100V,CER	641712	89536	641712	1		
C 3		CAP,VAR,9-90PF,50V,CER	643130	89536	643130	1		
C 4		CAP,CER,430PF,+-2%,50V,C0G,1206	851816	89536	851816	1		
C 5		CAP,TA,15UF,+-20%,6.3V	807636	56289	199D156X06R3BA1	1		
C 8, 9		CAP,POLYCA,0.027UF,+-10%,63V	720979	89536	720979	2		
C 10		CAP,POLYES,0.47UF,+-10%,50V	697409	84411	J1320R47MF10PCT50V	1		
C 11		CAP,POLYPR,0.022UF,+-10%,63V	821579	89536	821579	1		
C 14, 21		CAP,TA,47UF,+-20%,10V	746990	89536	746990	2		
C 15, 16, 32		CAP,CER,0.1UF,+-10%,25V,X7R,1206	747287	89536	747287	3		
C 17, 18		CAP,CER,22PF,+-10%,50V,C0G,1206	740563	89536	740563	2		
C 19		CAP,CER,8.2PF,+-10%,50V,C0G,1206	747303	89536	747303	1		
C 20		CAP,CER,5.6PF,+-0.25PF,1500V,C0H	851811	89536	851811	1		
C 22		CAP,CER,1000PF,+-10%,50V,C0G,1206	747378	89536	747378	1		
C 24		CAP,TA,10UF,+-20%,10V	714766	56289	199D106X0010BA1	1		
C 27		CAP,CER,100PF,+-10%,50V,C0G,1206	740571	89536	740571	1		
C 28, 29		CAP,TA,0.47UF,+-20%,50V	807990	89536	807990	2		
C 30		CAP,CER,220PF,+-10%,50V,C0G,1206	758078	89536	758078	1		
C 31, 33, 34		CAP,CER,0.01UF,+-10%,50V,X7R,1206	747261	89536	747261	3		
C 35		CAP,TA,4.7UF,+-20%,15V	745976	89536	745976	1		
C 36		CAP,CER,68PF,+-10%,50V,C0G,1206	853861	89536	853861	1		
CR 1, 4		DIODE,SI,1K PIV,1.0 AMP	707075	04713	SR4348RL	2	1	
CR 5, 7, 8	*	DIODE,SI,BV=70.0V,IO=50MA,DUAL,SOT23	742320	89536	742320	3	1	
E 1		SURGE PROTECTOR,1500V,+-20%	655134	89536	655134	1		
J 1		INPUT RCPT ASSY	826214	89536	826214	1		
Q 1, 2, 6	*	TRANSISTOR,SI,NPN,SELECTED IEBO,SOT23	821637	89536	821637	3	1	
Q 3, 9, 12	*	TRANSISTOR,SI,NPN,SMALL SIGNAL,SOT23	742676	89536	742676	3	1	
Q 8	*	TRANSISTOR,SI,N-DMOS FET,SOT23	830851	89536	830851	1	1	
Q 10	*	TRANSISTOR,SI,P-CHAN,SOT-23	832477	89536	832477	1	1	
Q 11	*	TRANSISTOR,SI,PNP,SMALL SIGNAL,SOT23	742684	89536	742684	1	1	
R 1		RES,MF,1K,+-1%,100PPM,FLMPRF,FUSIBLE	832550	89536	832550	1		
R 2	*	RES,TINOX,909K,+-1%,2W	831594	89536	831594	1		
R 3	*	RES,CERM,1.5K,+-5%,.125W,250PPM,1206	746438	89536	746438	1		
R 4		RES,MF,110.1,+-0.1%,0.125W,100PPM	821728	89536	821728	1		
R 5		RES,WW,0.991,+-0.1%,2.5W	821645	89536	821645	1		
R 6		RES,WW,0.010,+-0.1%,1W,100PPM	807305	89536	807305	1		
R 7, 10	*	RES,CERM,1M,+-5%,1W	655175	89536	655175	2		
R 8, 48	*	RES,CERM,15M,+-5%,.125W,300PPM,1206	811968	89536	811968	2		
R 9, 13, 29	*	RES,CERM,100K,+-5%,.125W,250PPM,1206	740548	89536	740548	3		
R 11	*	RES,CERM,10M,+-5%,.125W,250PPM,1206	783274	89536	783274	1		
R 12	*	RES,CERM,10K,+-5%,.125W,250PPM,1206	746610	89536	746610	1		
R 14		RES,MF,10K,+-0.1%,0.125W,100PPM	658955	89536	658955	1		
R 15		RES,MF,90K,+-0.1%,0.125W,100PPM	658906	89536	658906	1		
R 17, 18, 42,	*	RES,CERM,1M,+-5%,.125W,250PPM,1206	746826	89536	746826	4		
R 54	*		746826					
R 19	*	RES,CERM,56.2K,+-1%,.125W,100PPM,1206	831305	89536	831305	1		
R 20, 37	*	RES,CERM,205K,+-1%,.125W,100PPM,1206	769836	89536	769836	2		
R 21		RES,VAR,CERM,100K,+-20%,0.3W	649897	89536	649897	1		
R 24	*	RES,CERM,287K,+-1%,0.125W,100PPM,1206	853895	89536	853895	1		
R 25	*	RES,CERM,210K,+-1%,.125W,100PPM,1206	821660	89536	821660	1		
R 28	*	RES,CERM,84.5K,+-1%,.125W,100PPM,1206	853510	89536	853510	1		
R 30		RES,MF,20K,+-0.25%,0.125W,50PPM	715029	59124	MFF1-82002C	1		
R 31, 40		RES,MF,22.6K,+-0.25%,0.125W,50PPM	715011	59124	MFF1-82262C	2		
R 34		RES,VAR,CERM,1K,+-20%,0.3W	831420	89536	831420	1		
R 35	*	RES,CERM,620K,+-5%,.125W,250PPM,1206	811919	89536	811919	1		
R 38, 60	*	RES,CERM,536K,+-1%,.125W,100PPM,1206	845420	89536	845420	2		
R 41, 47	*	RES,CERM,0.05MAX,.125W,1206	810747	89536	810747	2		
R 43		RES,MF,1K,+-0.1%,0.125W,100PPM	821694	89536	821694	1		
R 44	*	RES,CERM,82K,+-5%,.125W,250PPM,1206	811794	89536	811794	1		
R 46		RES JUMPER,0.02,0.25W	682575	89536	682575	1		
R 56, 57	*	RES,CERM,22K,+-5%,.125W,250PPM,1206	746651	89536	746651	2		
R 58	*	RES,CERM,120K,+-5%,.125W,250PPM,1206	746719	89536	746719	1		
R 59	*	RES,CERM,510,+-5%,.125W,250PPM,1206	746388	89536	746388	1		
RT 1		THERMISTOR,RECT,POS,1.5K,+-30%,25 C	822015	89536	822015	1	1	
RV 1, 2		VARISTOR,910V,+-10%,1.0MA	817106	89536	817106	2	1	
S 1		SWITCH,ROTARY	819334	89536	819334	1		
U 1		DIODE,SI,RECT,BRIDGE,BV=50V,IO=1.0A	418582	14936	DF005	1		
U 4	*	IC CMOS OLYMPUS, ASSEMBLY TESTED	809301	89536	809301	1	1	
U 6	*	IC,CMOS,HEX INVERTER,SOIC	838375	89536	838375	1	1	

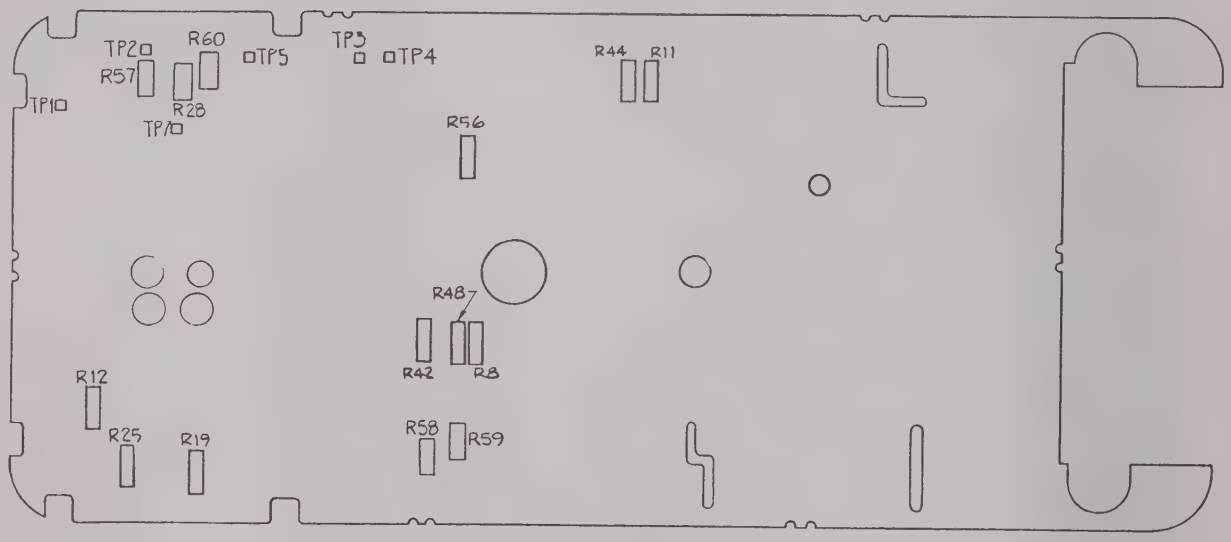
An * in 'S' column indicates a static-sensitive part.

Table 4-4. A1 Main PCA (cont.)

REFERENCE DESIGNATOR -A->-NUMERICS---->	S	DESCRIPTION	FLUKE STOCK --NO--	MFRS SPLY -CODE-	MANUFACTURERS PART NUMBER -OR GENERIC TYPE-----	TOT QTY-	R S -Q	N O T -E-
VR 1	*	BANDGAP, TAPED	729194	89536	729194	1	1	
W 1		JUMPER WIRE NEG	834994	89536	834994	1		
W 2		JUMPER WIRE,POS	835009	89536	835009	1		
XBT 1		CONNECTOR,BATTERY	825976	89536	825976	1		
XF 1		CONTACT,600V,FUSE	659524	89536	659524	1		1
XF 2		600 VOLT FUSE CONTACT	707190	89536	707190	2		2
Y 1		CRYSTAL,131.072KH2,0.003%,3X8MM	831453	89536	831453	1	1	
Z 1	*	RES NET THK FILM TESTED	813824	89536	813824	1		

An * in 'S' column indicates a static-sensitive part.

NOTE 1 = Ref. designator XF1 is two (2) parts. They are used with F1 on the Final Assembly.
NOTE 2 = Ref. designator XF2 is two (2) parts. They are used with F2 on the Final Assembly.



BOTTOM SIDE

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Figure 4-4. Fluke 85 A1 Main PCA

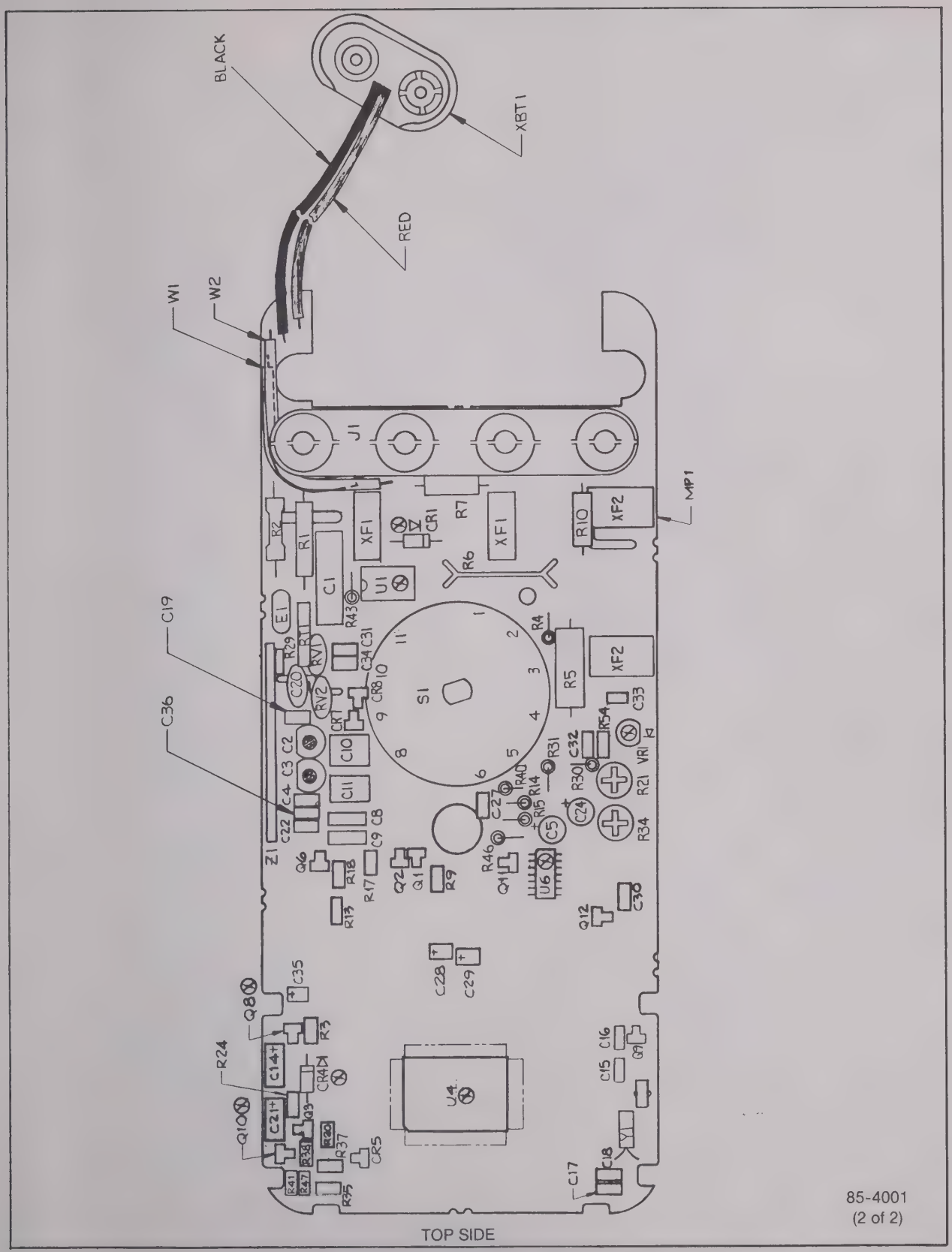

Figure 4-4. Fluke 85 A1 Main PCA (cont)

Table 4-5. Fluke 87 Final Assembly
(See Figure 4-5.)

REFERENCE DESIGNATOR -A->-NUMERICS---->	S	DESCRIPTION	FLUKE STOCK --NO--	MFRS SPLY -CODE-	MANUFACTURERS PART NUMBER -OR GENERIC TYPE-----	TOT QTY-	RS -Q	NOT -E-
A 1	*	MAIN PCA	819268	89536	819268	1		
BT 1		BATTERY,9V,0-200MA	614487	0FFP1	522	1	1	
CR 6		BACKLIGHT	819342	89536	819342	1		
E 1		CONTACT,PTF	822676	89536	822676	1	1	
E 2		CONTACT,ANNUNCIATOR	822791	89536	822791	1		
F 1		FUSE,.406X1.375,1A,600V,FAST	830828	71400	BBS-1	1	5	
F 2		FUSE,.406X1.5,15A,600V,FAST	820829	71400	KLK-15	1	5	
H 1		SCREW,THD FORM,PH,P,STL,4-14X0.562	832220	89536	832220	1		
H 2		SCREW,THD FORM,PH,P,STL,5-14X0.750	832246	89536	832246	3		
J 1, 2		CONN,ELASTOMERIC,LCD TO PWB,1.540 L	817460	89536	817460	2	1	
MP 1		MASK,LCD	822684	89536	822684	1		
MP 2		SHIELD,TOP	824516	89536	824516	1		
MP 3		SHAFT,SWITCH	822635	89536	822635	1		
MP 4		SHIELD,BOTTOM	824524	89536	824524	1		
MP 5		CASE,TOP & WINDOW ASSEMBLY	824532	89536	824532	1		1
MP 6		CASE,BOTTOM	819409	89536	819409	1		
MP 8		KNOB,SWITCH (PAD XFER)	857271	89536	857271	1		
MP 9		SPRING,DETENT	822643	89536	822643	1		
MP 10		FOOT,NON SKID	824466	89536	824466	3		
MP 12		GASKET,CASE	826198	89536	826198	1	1	
MP 13		SHOCK ABSORBER	828541	89536	828541	1		
MP 14		O-RING,SYN RUBBER,1.670 ID,0.047 WIDE	831933	89536	831933	1	1	
MP 15		HOLSTER&FLEXSTAND ASSY (YELLOW)	822809	89536	822809	1		
MP 19		TEST LEADS	642033	89536	642033	1		
MP 21		FOOT,ADHESIVE,RUBBER,GREY,.50X.23	853924	89536	853924	1		
S 1		SWITCH PAD, MOMENTARY	809970	89536	809970	1		
TM 5		87 USER'S MANUAL (ENGLISH)	852418	89536	852418	1		
TM 6		87 USER'S MANUAL (INTERNATIONAL)	852421	89536	852421	1		
U 5		LCD,4.5 DIGIT,BAR GRAPH,MULTIPLEXED	832188	89536	832188	1	1	

An * in 'S' column indicates a static-sensitive part.

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NOTE 1 = MP5 includes MP8 and MP9.

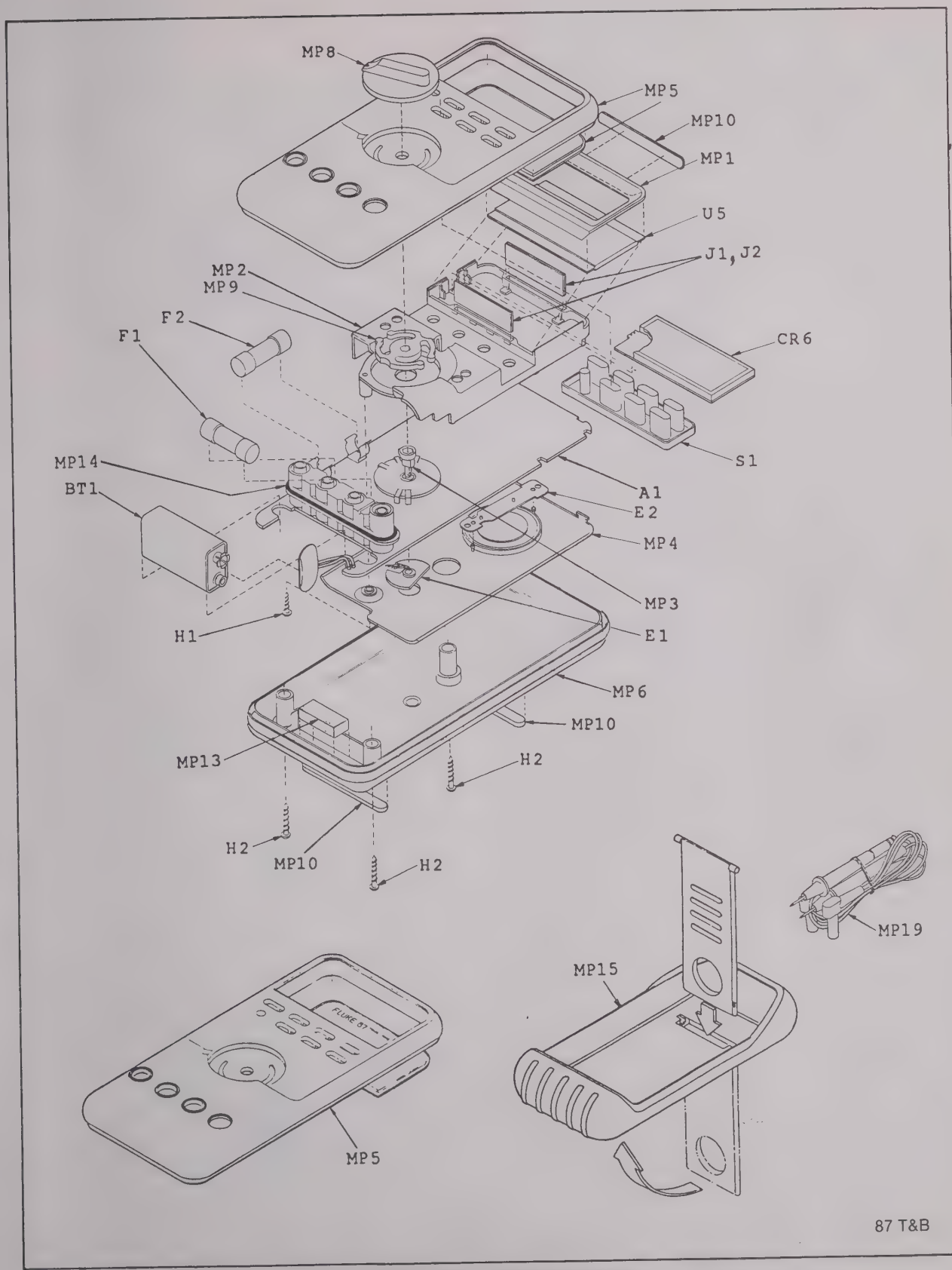


Figure 4-5. Fluke 87 Final Assembly

Table 4-6. A1 Main PCA
(See Figure 4-6.)

REFERENCE DESIGNATOR -A>-NUMERICS---->	S	DESCRIPTION	FLUKE STOCK --NO--	MFRS SPLY -CODE-	MANUFACTURERS PART NUMBER -OR GENERIC TYPE-----	TOT QTY-	R S -Q	NOT -E-
AR 1	*	IC,OP AMP,DUAL,FIX MED POWER,SOIC	830810	89536	830810	1	1	
C 1		CAP,POLYES,0.01UF,+-10%,1000V	822361	89536	822361	1		
C 2		CAP,VAR,3-11PF,100V,CER	641712	89536	641712	1		
C 3		CAP,VAR,9-90PF,50V,CER	643130	89536	643130	1		
C 4		CAP,CER,430PF,+-2%,50V,C0G,1206	851816	89536	851816	1		
C 5		CAP,TA,15UF,+-20%,6.3V	807636	56289	199D156X06R3BA1	1		
C 6		CAP,TA,22UF,+-20%,10V	658971	56289	199D226X0010CA1	1		
C 7		CAP,TA,10UF,+-20%,10V	714766	56289	199D106X0010BA1	1		
C 8, 9		CAP,POLYCA,0.027UF,+-10%,63V	720979	89536	720979	2		
C 10		CAP,POLYES,0.47UF,+-10%,50V	697409	84411	J1320R47MF10PCT50V	1		
C 11		CAP,POLYPR,0.022UF,+-10%,63V	821579	89536	821579	1		
C 12, 13		CAP,POLYPR,0.068UF,+-20%,100V	852132	89536	852132	2		
C 14, 21		CAP,TA,47UF,+-20%,10V	746990	89536	746990	2		
C 15, 16, 32		CAP,CER,0.1UF,+-10%,25V,X7R,1206	747287	89536	747287	3		
C 17, 18		CAP,CER,22PF,+-10%,50V,C0G,1206	740563	89536	740563	2		
C 19		CAP,CER,8.2PF,+-10%,50V,C0G,1206	747303	89536	747303	1		
C 20		CAP,CER,5.6PF,+-0.25PF,1500V,C0H	851811	89536	851811	1		
C 22		CAP,CER,1000PF,+-10%,50V,C0G,1206	747378	89536	747378	1		
C 27		CAP,CER,100PF,+-10%,50V,C0G,1206	740571	89536	740571	1		
C 30		CAP,CER,220PF,+-10%,50V,C0G,1206	758078	89536	758078	1		
C 31, 33, 34		CAP,CER,0.01UF,+-10%,50V,X7R,1206	747261	89536	747261	3		
C 35		CAP,TA,4.7UF,+-20%,15V	745976	89536	745976	1		
C 36		CAP,CER,68PF,+-10%,50V,C0G,1206	853861	89536	853861	1		
CR 1, 4		DIODE,SI,1K PIV,1.0 AMP	707075	04713	SR4348RL	2	1	
CR 2, 3	*	DIODE,SI,BV= 20.0V,IO= 50MA,250 MW	836288	89536	836288	2	1	
CR 5, 7, 8	*	DIODE,SI,BV=70.0V,IO=50MA,DUAL,SOT23	742320	89536	742320	3	1	
E 1		SURGE PROTECTOR,1500V,+-20%	655134	89536	655134	1		
J 1		INPUT RCPT ASSY	826214	89536	826214	1		
J 2		SOCKET,1 ROW,PWB,0.100CTR,2 POS	832634	89536	832634	1		
Q 1, 2, 6	*	TRANSISTOR,SI,NPN,SELECTED IEBO,SOT23	821637	89536	821637	3	1	
Q 3, 4, 7,	*	TRANSISTOR,SI,NPN,SMALL SIGNAL,SOT23	742676	89536	742676	5	1	
Q 9, 12	*		742676					
Q 5, 11	*	TRANSISTOR,SI,PNP,SMALL SIGNAL,SOT23	742684	89536	742684	2	1	
Q 8	*	TRANSISTOR,SI,N-DMOS FET,SOT23	830851	89536	830851	1	1	
Q 10	*	TRANSISTOR,SI,P-CHAN,SOT-23	832477	89536	832477	1	1	
R 1		RES,MF,1K,+-1%,100PPM,FLMPRF,FUSIBLE	832550	89536	832550	1	1	
R 2	*	RES,TINOX,909K,+-1%,2W	831594	89536	831594	1		
R 3	*	RES,CERM,1.5K,+-5%,.125W,250PPM,1206	746438	89536	746438	1		
R 4		RES,MF,110.1,+-0.1%,0.125W,100PPM	821728	89536	821728	1		
R 5		RES,WW,0.991,+-0.1%,2.5W	821645	89536	821645	1		
R 6		RES,WW,0.010,+-0.1%,1W,100PPM	807305	89536	807305	1		
R 7, 10	*	RES,CERM,1M,+-5%,1W	655175	89536	655175	2		
R 8, 48	*	RES,CERM,15M,+-5%,.125W,300PPM,1206	811968	89536	811968	2		
R 9, 13, 29,	*	RES,CERM,100K,+-5%,.125W,250PPM,1206	740548	89536	740548	4		
R 53	*		740548					
R 11	*	RES,CERM,10M,+-5%,.125W,250PPM,1206	783274	89536	783274	1		
R 12	*	RES,CERM,10K,+-5%,.125W,250PPM,1206	746610	89536	746610	1		
R 14		RES,MF,10K,+-0.1%,0.125W,100PPM	658955	89536	658955	1		
R 15		RES,MF,40K,+-0.1%,0.125W,100PPM	821702	89536	821702	1		
R 17, 18, 42,	*	RES,CERM,1M,+-5%,.125W,250PPM,1206	746826	89536	746826	4		
R 54	*		746826					
R 19	*	RES,CERM,56.2K,+-1%,.125W,100PPM,1206	831305	89536	831305	1		
R 20, 37	*	RES,CERM,205K,+-1%,.125W,100PPM,1206	769836	89536	769836	2		
R 21		RES,VAR,CERM,100K,+-20%,0.3W	649897	89536	649897	1		
R 22, 23	*	RES,CERM,2K,+-5%,.125W,250PPM,1206	746461	89536	746461	2		
R 24	*	RES,CERM,287K,+-1%,0.125W,100PPM,1206	853895	89536	853895	1		
R 25	*	RES,CERM,210K,+-1%,.125W,100PPM,1206	821660	89536	821660	1		
R 28	*	RES,CERM,84.5K,+-1%,.125W,100PPM,1206	853510	89536	853510	1		
R 31		RES JUMPER,0.02,0.25W	682575	89536	682575	1		
R 32	*	RES,CERM,75K,+-5%,.125W,250PPM,1206	811901	89536	811901	1		
R 34		RES,VAR,CERM,100+-20%,0.3W	831412	89536	831412	1		
R 35	*	RES,CERM,620K,+-5%,.125W,250PPM,1206	811919	89536	811919	1		
R 38, 60	*	RES,CERM,536K,+-1%,.125W,100PPM,1206	845420	89536	845420	2		
R 39	*	RES,CERM,56K,+-5%,.125W,250PPM,1206	746701	89536	746701	1		
R 43		RES,MF,1K,+-0.1%,0.125W,100PPM	821694	89536	821694	1		
R 44	*	RES,CERM,82K,+-5%,.125W,250PPM,1206	811794	89536	811794	1		
R 45, 50	*	RES,CERM,0.05MAX,.125W,1206	810747	89536	810747	2		
R 46		RES,MF,50K,+-0.1%,0.125W,100PPM	821710	89536	821710	1		
R 56, 57	*	RES,CERM,22K,+-5%,.125W,250PPM,1206	746651	89536	746651	2		

An * in 'S' column indicates a static-sensitive part.

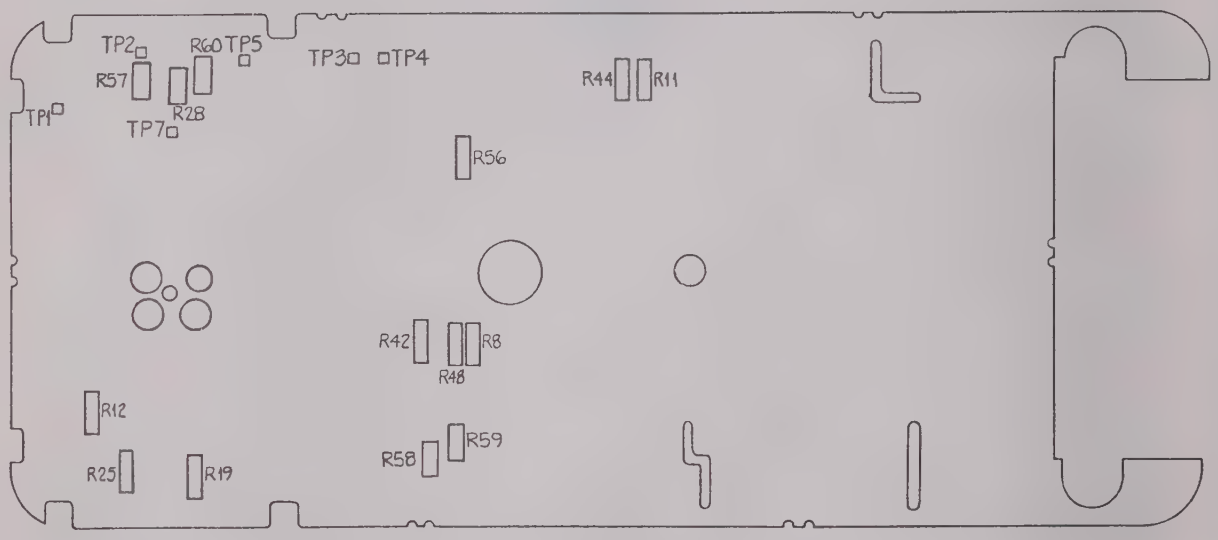
Table 4-6. A1 Main PCA (cont.)

REFERENCE DESIGNATOR -A->-NUMERICS---->	S	DESCRIPTION	FLUKE STOCK --NO--	MFRS SPLY -CODE-	MANUFACTURERS PART NUMBER -OR GENERIC TYPE-----	TOT QTY-	R S -Q	NOT -E-
R 58	*	RES,CERM,120K,+-5%,.125W,250PPM,1206	746719	89536	746719	1		
R 59	*	RES,CERM,510,+-5%,.125W,250PPM,1206	746388	89536	746388	1		
RT 1		THERMISTOR,RECT,POS,1.5K,+-30%,25 C	822015	89536	822015	1	1	
RV 1, 2		VARISTOR,910V,+-10%,1.0MA	817106	89536	817106	2	1	
S 1		SWITCH,ROTARY	819334	89536	819334	1		
U 1		DIODE,SI,RECT,BRIDGE,BV=50V,IO=1.0A	418582	14936	DF005	1	1	
U 2	*	TAPE & REEL, SMD, SO	835538	89536	835538	1		
U 4	*	IC CMOS OLYMPUS, ASSEMBLY TESTED	842294	89536	842294	1		
U 6	*	IC,CMOS,HEX INVERTER,SOIC	838375	89536	838375	1	1	
VR 1	*	BANDGAP, TAPED	729194	89536	729194	1	1	
W 1		JUMPER WIRE NEG	834994	89536	834994	1		
W 2		JUMPER WIRE,POS	835009	89536	835009	1		
XBT 1		CONNECTOR,BATTERY	825976	89536	825976	1		
XF 1		CONTACT,600V,FUSE	659524	89536	659524	2		1
XF 2		600 VOLT FUSE CONTACT	707190	89536	707190	2		1
Y 1		CRYSTAL,131.072KHZ,0.003%,3X8MM	831453	89536	831453	1	1	
Z 1	*	RES NET THK FILM TESTED	813824	89536	813824	1		

An * in 'S' column indicates a static-sensitive part.

NOTE 1 = Ref. designator XF1 is two (2) parts. They are used with F1 on the Final Assembly.

NOTE 2 = Ref. designator XF2 is two (2) parts. They are used with F2 on the Final Assembly.



BOTTOM SIDE

87-4001
(1 of 2)

Figure 4-6. Fluke 87 A1 Main PCA

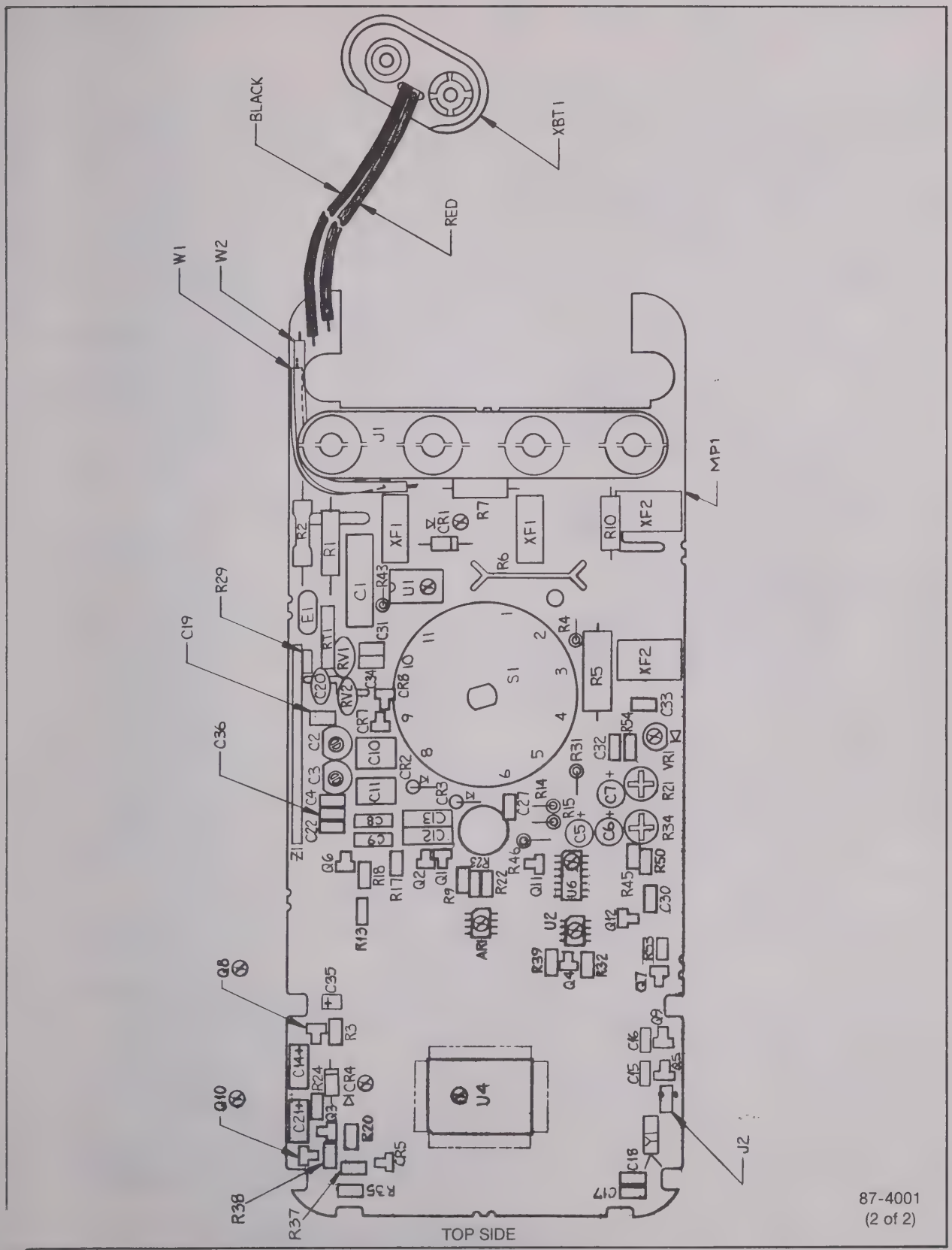


Figure 4-6. Fluke 87 A1 Main PCA (cont)

Alabama

Huntsville
4920 Corporate Drive
Suite J
Huntsville, AL 35805-6202
(205) 837-0581

Arizona

Tempe
2211 S. 48th Street
Suite B
Tempe, AZ 85282
(602) 438-8314

Tucson
(602) 790-9881

California

Northern
46610 Landing Parkway
Fremont, CA 94538
(415) 651-5112

Irvine
P.O. Box 19676
Irvine, CA 92713-9676
16969 Von Karman
Suite 100
Irvine, CA 92714
(714) 863-9031

Burbank
(213) 849-7181

Los Angeles
(213) 747-5935

San Diego
(619) 292-7657

Colorado

Denver
14180 E. Evans Ave.
Aurora, CO 80014
(303) 695-1000

Connecticut

Hartford
Glen Lochen East
41-C New London Turnpike
Glastonbury, CT 06033
(203) 659-3541

Florida

Clearwater
(813) 799-0087

Miami
(305) 462-1380

Orlando
940 N. Fern Creek Ave.
Orlando, FL 32803
(407) 896-4881

Tampa
(813) 251-9211

Georgia

Atlanta
2700 Delk Road
Suite 150
Marietta, GA 30067
(404) 953-4747

Illinois

Chicago
1150 W. Euclid Avenue
Palatine, IL 60067
(312) 705-0500

Indiana

Indianapolis
8777 Purdue Road
Suite 101
Indianapolis, IN 46268
(317) 875-7870

Louisiana

New Orleans
(504) 455-0814

Massachusetts

Boston
Middlesex Technology Center
900 Middlesex Turnpike
Building 8
Billerica, MA 01821
(508) 663-2400

Maryland

Baltimore
(301) 792-7060

Rockville
5640 Fishers Lane
Rockville, MD 20852
(301) 770-1570

Michigan

Detroit
45550 Helm Street
Metro West Industrial Park
Plymouth, MI 48170
(313) 522-9140

Minnesota

Eagen
1380 Corporate Center Curve
Suite 113
Eagan, MN 55121
(612) 854-5526

Missouri

St. Louis
11756 Borman Drive
Suite 160
St. Louis, MO 63146
(314) 993-3805

North Carolina

Greensboro
1310 Beaman Place
Greensboro, NC 27408
(919) 273-1918

New Jersey

Paramus
P.O. Box 930
Paramus, NJ 07653-0930
West 75 Century Road
Paramus, NJ 07652
(201) 262-9550

New Mexico

Albuquerque
(505) 881-3550

New York

Rochester
4515 Culver Road
Rochester, NY 14622
(716) 323-1400

Ohio

Cleveland
Plaza South Three
Suite 402
7271 Engle Road
Middleburg Heights, OH 44130
(216) 234-4540

Oklahoma

Northeast
(405) 236-2977

Tulsa
(918) 665-3530

Oregon

Portland
(503) 227-2042

Pennsylvania

Malvern
200 Lindenwood Drive
Malvern, PA 19355
(215) 647-9550

Pittsburgh
(412) 261-5171

Texas

Austin
(512) 459-3344

Dallas
1801 Royal Lane
Suite 307
Dallas, TX 75229
(214) 869-0311

El Paso
(915) 533-3508

Houston
(713) 240-5995

San Antonio
10417 Gulfdale
San Antonio, TX 78216
(512) 340-0498

Utah

Salt Lake City
(801) 268-9331

Washington

Seattle
5020 148th Ave. N.E.
Suite 110
Redmond, WA 98052
(206) 881-6966

Washington, DC

Washington, DC
(301) 770-1570

lgeria
ureau de Liaison Philips
4 rue Bougainville
l Mouradis, Alger
el: 60 14 05
LX: 62221

rgentina
oasin S.A.
irrey del Pino 4071DPTO E-65
430 CAP FED
uenos Aires, Argentina
el: (54) (1) 552-5248
LX: (390) 22284

ustralia
hilips Scientific & Industrial
ty Ltd.
entrecourt 25-27 Paul Street
orth Ryde
ydney N.S.W. 2113
el: (61) 88 88 222
AX: (61) 2-888-0440

ustria
sterreichische Philips
ndustrie GmbH
eschaftsbereich I & E
larktbereich Test-und MeBgerate
-1101 WIEN, Triester StraBe 64
el: (0222) 60101/1722 DW

angladesh
otherland Corporation
4 Hatkhola Road, Tikatuli
acca-3, Bangledesh
el: 257249
LX: (950) 642022

elgium
.V. Philips Professional
ystems S.A.
est and Measurement
weestationsstraat 80
ue des Deux Gares
russel 1070 Bruxelles
el: 2-5256111

olivia
oasin Bolivia S.R.L.
asilla 7295
Paz, Bolivia
el: (591) (2) 40962
LX: (336) 3233 COALAP BV

razil
FP Hi-Tek Eletronica Ltda.
. Amazonas 422, Alphaville
arueri 06400
ao Paulo, Brazil
el: (55) (11) 421-5477
LX: (391) 1171413

runei
ank O'Connor's, Sdn Bhd
o. 8 Block D
ufri Shophouse Complex
le 1 Jalan Tutong
ndar Seri Begawan
egara Brunei Darussalam
el: (673) (2) 23109 or 23557
LX: (799) BU2265 RANKOC

Canada
Fluke Electronics Canada Inc.
400 Britannia Rd. East Unit #1
Mississauga, Ontario
L4Z 1X9 Canada
Tel: (416) 890-7600
FAX: (416) 890-6866

Fluke Electronics Canada Inc.
1690 Woodward Drive, Suite 216
Ottawa, Ontario
K2C 3R8 Canada
Tel: (613) 723-9453
FAX: (613) 723-9458

Fluke Electronics Canada Inc.
1255 Trans Canada Highway
Suite 130
Dorval, Quebec
H9P 2V4 Canada
Tel: (514) 685-0022
FAX: (514) 685-0039

Fluke Electronics Canada Inc.
101, 1144 - 29th Ave. N.E.
Calgary, Alberta
T2E 7P1 Canada
Tel: (403) 291-5215
FAX: (403) 291 5219

Chile
Intronica Chile, Ltda.
Casilla 16228
Santiago 9, Chile
Tel: (56) 2-2321886
TLX: (332) 346351

China, Peoples Republic of
Fluke Asia Ltd.
Shun Tak Centre, Suite No. 1501
200 Connaught Road
Central, Hong Kong
Tel: (852) 5-482116
TLX: (780) 67058 Fluke
FAX: (852) 5-479863

Colombia
Sistemas E Instrumentation, Ltda.
Carrera 21, No. 39A - 21, Of. 101
Ap. Aereo 29583, Bogota, Colombia
Tel: (57) 232-4532
TLX: (396) 45787

Denmark
Philips A/S Test & Measurement
Prags Boulevard 80
DK-2300-Kobenhavn S
Tel: (01) 572222
TLX: 31201

Ecuador
Proteco Coasin Cia., Ltda.
P.O. Box 228-A
Ave. 12 de Octubre 2285 y Orellana
Quito, Ecuador
Tel: (593) (2) 529684
TLX: (393) 22085

Proteco Coasin Cia., Ltda.
P.O. Box 9733
Ave. Principal No. 204 y Calle
Segunda
Urbanizacion Miraflores
Guayaquil, Ecuador
Tel: (593) (4) 387519

Egypt
Philips Egypt Liaison
Office of Philips
Export B.V.
10, Abdel Rahman el Rafei Str.
P.O. Box 1687
Dokki, Cairo
Tel: 20-2-3490922
TLX: 228 16 PHEGY UN

Ethiopia
Philips Ethiopia (Priv. Ltd. Co.)
Ras Abebe Areguay Avenue
P.O. Box 2565, Addis Ababa
Tel: 148300

Fiji
Awa New Zealand Ltd.
37 Freestone Walu Bay Road
P.O. Box 858, Suva, Fiji
Tel: (679) 312079
TLX: (792) 2347
FAX: (679) 314379

Finland
Instrumentarium Elektronikka
P.O. Box 64
02631 Espoo 63, Finland
Tel: (358) (0) 5281
TLX: (857) 124426
FAX: (358) 0-502-1073

France
S.A. Philips Industrielle et
Commercials
Division Science de Industrie
105 rue de Paris, BP 62
93002 BOBIGNY Cedex
Tel: (1) 49 42 80 80
TLX: 210290

Germany
Philips GmbH
Unternehmensbereich
Elektronik fur Wissenschaft
und Industria
Vertriebsbereich Testr & MeBtechnik
MiramstraBe 87 Postfach 310320
D-3500 KASSEL
Tel: (0561) 5010
TLX: 997070

Bereich Fluke Produkts
Oskar-Messter-Strape 18
D-8045 Ismaning

Great Britain
Philips Test & Measurement
Colonial Way
Watford WD2 4TT

Greece
Philips S.A. Hellenique I&E Division
15, 25th March Street
GR-17778 TAVROS or
P.O. Box 3153 Athens
Tel: 30-1-4894911
TLX: 241566-241567

Hong Kong
Schmidt & Co (H.K.), Ltd
18th Floor, Great Eagle Centre
23 Harbour Road
Wanchai, Hong Kong
Tel: (852) (5) 8330-222
TLX: (780) 74766 or 76762
FAX: (852) 5-8918754

India
Hinditron Services Pvt., Ltd.
69/A.L. Jagmohandas Marg
Bombay 400 006, India
Tel: (91) (22) 8121316,
(91) (22) 8125344
TLX: (953) 1175326
FAX: (91) 22-822-0197

Hinditron Services Pvt., Ltd.
8th Main Road
33/44A Raj Mahal Vilas Extension
Bangalore 560 080, India
Tel: (91) 812-363139
TLX: (953) 8452741

Hinditron Services Pvt., Ltd.
5th Floor, "Castle House"
5/1A, Hungerford St.
Calcutta 700 017, India
Tel: (91) 33-432628
TLX: (953) 21-4153

Hinditron Services Pvt., Ltd.
204-5-6 Hemkunt Tower
98 Nehru Place
New Delhi, 110019, India
Tel: (91) 11-6410380
TLX: (953) 316458

Hinditron Services Pvt., Ltd.
Emerald Complex 1-7-264 5th Floor
114 Sarojini Devi Rd.
Secunderabad 500 003, India
Tel: (91) 842 821117
TLX: (953) 04256973

Indonesia
P.T. Lamda Triguna
P.O. Box 6/JATJG, Jakarta 13001
Tel: (62) 21-8195365
TLX: (796) 63938
FAX: (62) 21-819-9631

Iran
Philips Iran Ltd.
(Private Joint Stock Comp.)
P.O. Box 11365-3891, Tehran
Tel: 98-21-674138
TLX:212545PHPS IR

Iraq
Philips Medden Oosten B.V.
Baghdad Branch
Hai Al Whida. Area No. 902
Street No. 12, Bldg. 141/10
P.O. Box 5749, Baghdad
Tel: 7187181
TLX: 212439 Philips IK

Ireland
P.J. Brennan and Company Ltd.
61 Stillorgan Industrial Park
Stillorgan, Co. Dublin
Tel: 952501
TLX: 3817
FAX: 952333

Israel
R.D.T. Electronics Engineering Ltd.
P.O. Box 43137
Tel Aviv 61430 Israel
Tel: (972) (3) 483211
TLX: 371452
FAX: 972-3-492190

Italy
Philips S.p.A.
Sezione S & I, T & M Dept.
Viale Elvezia 2, 20052 Monza
Tel: (039) 3635240/8/9
TLX: 333343

Japan
John Fluke Mfg. Co., Inc.
Japan Branch
Sumitomo Higashi Shinbashi Bldg.
1-1-11 Hamamatsucho
Minato-ku, Tokyo 105, Japan
Tel: (81) (3) 434-0188
TLX: (781) 2424331
FAX: 81-3-434-0170

John Fluke Mfg. Co., Inc.
Japan Branch
Katsushige Building
2-45 Kohraibashi
Higashi-ku, Osaka 541, Japan
Tel: (81) (6) 229-0871
FAX: 81-6-229-1098

Kenya
Philips (Kenya) Ltd.
OL Kalou Road, Industrial Area
P.O. Box 30554, Nairobi
Tel: 254-2-557999
TLX: 22225 Nairobi

Korea, Republic of
Myoung Corporation
Yeo Eui Do
P.O. Box 14, Seoul, Korea
Tel: (82) (2) 784-9942
TLX: (787) MYOUNG K24283
FAX: (82) 2-784-2387

Kuwait
Al Bahar International Group
P.O. Box 26672 Safat
13127 Safat, Kuwait
Tel: (965) 848601
TLX: (959) 44822

Lebanon
Philips Middle East S.A.R.L.
B.P. 11-670
Ave. Sami Solh, Beyrouth
Tel: 392320/1
TLX: 20765 LE PHIBAN

Malaysia
Mecomb Malaysia Sdn Bhd
P.O. Box 24
46700 Petaling Jaya
Selangor, Malaysia
Tel: (60) 3-7743422
TLX: (784) MA37764
FAX: (60) 3-774 3414

Mexico
Mexicana de Electronica Industrial S.A. (MEXEL)
Diagonal No. 27
Entre Calle de Eugenia Y Ave.
Colonia del Valle, C.P. 03100, Mexico
Tel: (905) 660-4323
TLX: (383) 1771038
FAX: 525-687-8695

Morocco
Somaciel
304 Boulevard Mohamed V,
Casablanca 05
Tel: 30 80 51/52
TLX: 27021

Nepal
Associated Enterprises
GPO Box 790, Pyaphal Tole
Kathmandu, Nepal
Tel: 13868
TLX: (947) 2568

Netherlands
Philips Nederland
Philips I&E Systems Div.
Building TQIII-4
5600 MD Eindhoven, The Netherlands
Tel: (31) 40-786839
TLX: (844) 35000 PHTC NL
FAX: (31) 40-785968

New Zealand
Philips Scientific & Industrial Pty Ltd.
2 Wagener Place, P.O. Box 4 021
Auckland 3, New Zealand
Tel: (64) (09) 894-160
TLX: NZ 2395
FAX: (64) (9) 862-728

Nigeria
Associated Electronic Products (Nigeria) Ltd.
KM 16, Ikorodu Road, Ojota
P.O. Box 1921,Lagos
Tel: 234-1-900160/69
TLX: 21961 NG

Norway
Morgenstierne & Co A/S
Konghellegate 3
P.O. Box 6688, Rodelokka
Oslo 5, Norway
Tel: (47) (2) 356110
TLX: (856) 71719
FAX: (47) 2-381457

Pakistan
International Operations (PAK Private), Ltd.
505 Muhammadi House
I.I. Chundrigar Road
P.O. Box 5323, Karachi, Pakistan
Tel: (92) (21) 221127
TLX: (952) 24494

Peru
Importaciones y Representaciones Electronicas S.A.
Avda. Franklin D. Roosevelt 105
Lima 1, Peru
Tel: (51) (14) 28-8650
TLX: (394) 25663

Philippines, Republic of
Spark Radio & Electronics, Inc.
Greenhills 1502, P.O. Box 610
San Juan, Metro Manila,
Philippines
Tel: (63) (2) 775192
TLX: (712) 4005

Portugal
Decada Equipamentos de Electronica
Av. Bombeiros Voluntarios
Lote 102B, Miraflores/Alges
1495 Lisbon, Portugal
Tel: (351) (1) 4103420
TLX: (832) 15515
FAX: (351) 1-410-1844

Singapore, Republic of
Rank O'Connor's PTE Ltd.
O'Connor House
98 Pasir Panjang Road
Singapore 0511
Republic of Singapore
Tel: (65) 4737944
TLX: (786) RS21023

South Africa
South African Philips (Pty) Ltd.
P.O.B. 7703
10 Bond Street, Randburg 2194
Johannesburg 2000
Tel: (27) (011) 889-3911

Spain
Philips Iberica S.A.E. Dpto
Aparatos de Medida
Martinez Villergas 2, Madrid 28027
Tel: 404-2200

Sri Lanka
Computerlink Data Systems, Ltd.
331 Union Place
Colombo, 2, Sri Lanka
Tel: (94) (1) 28641/2
TLX: (954) 22455

Sweden
Philips Foersaeljning AB
Division Industrielektronik
Test & Measurement
S-115 84 Stockholm
Tel: (08) 782 18 00

Switzerland
Philips AG Test-und Messtechnik
Postfach, CH-8027 Zurich
Tel: (01) 4882390

Syria
Philips Moyen-Orient S.A.R.L.
Rue Fardoss 79, P.O. Box 2442
Damascus
Tel: 218605/221650
TLX: PHISYR 411203 SY

Taiwan
Schmidt Electronics Corp.
5th Floor, Cathay Min-Sheng
Commercial Building,
344 Min-Sheng East Road
Taipei 104, Taiwan R.O.C.
Tel: (886) (2) 501-3468
TLX: (785) 11111
FAX: (886) 2-5029692

Tanzania
Philips (Tanzania) Ltd.
T.D.F.L. Building - 1st Floor
P.O. Box 20104
Ohio/Upanga Rd.
Dar es Salaam
Tel: 29571/4
TLX: 41016

Thailand
Measuretronix Ltd.
2102/63 Ramkamhaeng Road
Bangkok 10240, Thailand
Tel: (66) (2) 374-2516
TLX: (788) 82796
FAX: (66) 2-374-9965

Tunisia
STIET
32bis rue Ben Ghedahem, Tunis
Tel: 348666
TLX: (934) 13030

Turkey
Turk Philips Ticaret A.S.
Inonu Caddesi 78/80, P.K. 504
80074 Beyoglu-Istanbul
Tel: 90-1-1435910
TLX: 24192 PHTRTR

United Arab Emirates
Philips Middle East
Dubai International Trade Centre
11th Floor
P.O. Box 9269, Dubai
Tel: 971-4-377000
TLX: 46350 PMOA EM

5/8

Uruguay
Coasin Uruguaya S.A.
Libertad 2529
Casilla de Correo 1400
Montevideo, Uruguay
Tel: (598) (2) 789015
TLX: (398) UY23010

Venezuela
Coasin C.A.
Calle 9 Con Calle 4, Edif Edinurbi
Apartado de Correos NR-70.136
Los Ruices
Caracas 1070-A, Venezuela
Tel: (58) 2-241-0309
TLX: (395) 21027

Zaire
Philips Electronics S.A.R.L.
137, Boulevard du 30 juin
B.P. 16636, Kinshasa
Tel: 31693
TLX: 21078 KINSHASA

Zambia
Philips Electrical Zambia Ltd.
Mwembeshi Road
P.O. Box 1878, Lusaka
Tel: 218511/218701
TLX: Za 41220

Zimbabwe
Philips Electrical (Pvt.) Ltd.
62 Mutare Road
P.O. Box 994, Harare
Tel: 47211/48031
TLX: 2236

For other countries not listed above:
Fluke Int'l Corp
P.O. Box C9090
Mail Stop 206A
Everett, WA 98206
Tel: 206-356-5511
TLX: 185103 FLUKE UT
FAX: (206) 356-5116

U.S. Service Locations

California
Fluke Technical Center
16969 Von Karman Avenue
Suite 100
Irvine, CA 92714
Tel: (714) 863-9031

Fluke Technical Center
46610 Landing Parkway
Fremont, CA 94538
Tel: (415) 651-5112

Colorado
Fluke Technical Center
14180 East Evans Avenue
Aurora, CO 80014
Tel: (303) 695-1171

Florida
Fluke Technical Center
940 N. Fern Creek Avenue
Orlando, FL 32803
Tel: (407) 896-4881

Illinois
Fluke Technical Center
1150 W. Euclid Ave.
Palatine, IL 60067
Tel: (312) 705-0500

Maryland
Fluke Technical Center
5640 Fishers Lane
Rockville, MD 20852
Tel: (301) 770-1576

New Jersey
Fluke Technical Center
East 66 Midland Avenue
Paramus, NJ 07652-0930
Tel: (201) 599-9500

Texas
Fluke Technical Center
1801 Royal Lane, Suite 307
Dallas, TX 75229
Tel: (214) 869-2848

Washington
Fluke Technical Center
John Fluke Mfg. Co., Inc.
1420 75th St. S.W.
M/S 6-30
Everett, WA 98203
Tel: (206) 356-5560

International

Argentina
Coasin S.A.
Virrey del Pino 4071 DPTO E-65
1430 CAP FED
Buenos Aires
Tel: 54 1 522-5248

Australia
Philips Customer Support
Scientific and Industrial
23 Lakeside Drive
Tally Ho Technology Park
East Burwood
Victoria 3151

Australia
Philips Customer Support
Scientific & Industrial
25-27 Paul St. North
North Ryde N.S.W. 2113
Tel: 61 02 888 8222

Austria
Oesterreichische Philips Industrie
Unternehmensbereich Prof. Systeme
Triesterstrasse 66
Postfach 217
A-1101 Wein
Tel: 43 222-60101, x1388

Belgium
Philips & MBLE Associated S.A.
Scientific & Industrial Equip. Div
Service Department.
80 Rue des deux Gares B-1070
Brussels
Tel: 32 2 525 6111

Brazil
Hi-Tek Electronica Ltda.
Al. Amazonas 422, Alphaville
CEP 06400 Barueri
Sao Paulo
Tel: 55 11 421-5477

Canada
Fluke Electronics Canada Inc.
400 Britannia Rd. East, Unit #1
Mississauga
Ontario L4Z 1X9
Tel: 416-890-7600

Chile
Intronica Chile Ltda.
Casilla 16228
Santiago 9
Tel: 56 2 2321886, 2324308

China
Fluke International Corp.
P.O. Box 9085
Beijing
Tel: 86 01 512-3436

Colombia
Sistemas E Instrumentacion, Ltda.
Carrera 13, No. 37-43, Of. 401
Ap. Aereo 29583
Bogota DE
Tel: 57 232-4532

Denmark
Philips A/S
Technical Service I & E
Strandlodsveij 1A
PO Box 1919
DK-2300
Copenhagen S
Tel: 45 1 572222

Ecuador
Proteco Coasin Cia., Ltda.
P.O. Box 228-A
Ave. 12 de Octubre
2285 y Orellana
Quito
Tel: 593 2 529684

Egypt
Philips Egypt
10, Abdel Rahman el Rafei st.
el. Mohandessin
P.O. Box 242
Dokki Cairo
Tel: 20-2-490922

England
Philips Scientific
Test & Measuring Division
Colonial Way
Watford
Hertforshire WD2 4TT
Tel: 44 923-40511

Finland
Oy Philips AB
Central Service
Sinikalliontie 1-3
P.O. Box 11
SF-02630 ESPOO
Tel: 358-0-52572

France
S.A. Philips Industrielle
et Comerciale,
Science et Industry
105 Rue de Paris Bp 62
93002 Bobigny, Cedex
Tel: 33-1-4942-8040

Germany (F.R.G.)
Philips GmbH
Service fuer FLUKE - Produkte
Department VSF
Oskar-Messter-Strasse 18
D-8045 Ismaning/Munich,
West Germany
Tel: 49 089 9605-239

Greece
Philips S.A. Hellenique
15, 25th March Street
177 78 Tavros
10210 Athens
Tel: 30 1 4894911

Hong Kong
Schmidt & Co (H.K.) Ltd.
18/FL., Great Eagle Centre
23 Harbour Road
Wanchai
Tel: 852 5 8330222

India
Hinditron Services Pvt. Ltd
1st Floor, 17-B,
Mahal Industrial Estate
Mahakali Road, Andheri East
Bombay 400 093
Tel: 91 22 6300043

Hinditron Services Pvt. Inc.
33/44A Raj Mahal Villas Extn.
8th Main Road
Bangalore 560 080
Tel: 91 812 363139

Hinditron Services Pvt. Ltd.
Field Service Center
Emerald Complex 1-7-264
5th Floor
114 Sarojini Devi Road
Secunderabad 500 003
Tel: 08 42-821117

Hindtron Services Pvt. Ltd.
15 Community Centre
Panchshila Park
New Delhi 110 017
Tel: 011-6433675

Indonesia
P.T. Lamda Triguna
P.O. Box 6/JATJG
Jakarta 13001
Tel: (021) 8195365

Israel
R.D.T. Electronics Engineering, Ltd.
P.O. Box 43137
Tel Aviv 61430
Tel: 972 3 483211

Italy
Philips S.p.A.
Sezione I&E / T&M
Viale Elvezia 2
2005 Monza
Tel: 39 39 3635342

Japan
John Fluke Mfg. Co., Inc.
Japan Branch
Sumitomo Higashi Shinbashi Bldg.
1-1-11 Hamamatsucho
Minato-ku
Tokyo 105
Tel: 81 3 434-0181

Korea
Myoung Corporation
Yeo Eui Do P.O. Box 14
Seoul 150
Tel: 82 2 784-9942

Malaysia
Mecomb Malaysia Sdn. Bhd.
P.O. Box 24
46700 Petaling Jaya
Selangor
Tel: 60 3 774-3422

Mexico
Mexel Servicios en Computacion
Instrumentacion y Perifericos
Blvd. Adolfo Lopez Mateos No. 163
Col. Mixcoac
Mexico D.F.
Tel: 52-5-563-5411

Netherlands
Philips Nederland
Test & Meetapparaten Div.
Postbus 115
5000 AC Tilburg
Tel: 31-13-352445

New Zealand
Philips Customer Support
Scientific & Industrial Division
2 Wagener Place
Mt. Albert
Auckland
Tel: 64 9 894-160

Norway
Morgenstierne & Co. A/S
Konghellegate 3
P.O. Box 6688, Rodelokka
Oslo 5
Tel: 47 2 356110

Pakistan
International Operations (PAK) Ltd.
505 Muhammadi House
I.I. Chundrigar Road
P.O. Box 5323
Karachi
Tel: 92 21 221127, 239052

Peru
Importaciones & Representaciones
Electronicas S.A.
Avad Franklin D. Roosevelt 105
Lima 1
Tel: 51 14 288650

Philippines
Spark Radio & ElectronicS Inc.
Greenhills, P.O. Box 610
San Juan, Metro-Manila Zip 3113
Tel: 63-2-775192

Portugal
Decada Espectral
Equipmentos de Elec. e Cientificos
Av. Bomberios Voluntarios
Lote 102B, Miraflores/Alges
1495 Lisboa
Tel: 351 1 410-3420

Singapore
Rank O'Connor's Singapore (PTE) Ltd.
98 Pasir Panjang Road
Singapore 0511
Tel: 65 4737944

South Africa
South African Philips (Pty) Ltd.
Service Department
195 Main Rd
Martindale, Johannesburg, 2092
Tel: 27 11 470-5255

Spain
Philips Iberica S.A.E.
Depto. Tecnico Instrumentacion
c/Martinez Villergas 2
28027 Madrid
Tel: 34 1 4042200

Sweden
Philips Kistaindustrier AB
Customer Support
Borgarfjordsgatan 16
S-16493 Kista

Switzerland
Philips A.G.
Technischer Kundendienst
Postfach 670
Allmendstrasse 140
CH-8027 Zurich
Tel: 41 1 482211

Taiwan
Schmidt Electronics Corp.
5th Floor, Cathay Min Sheng
Commercial Building,
344 Min Sheng East Road
Taipei
Tel: 886 2501-3468

Thailand
Measuretronix Ltd.
2102/63 Ramkamhaeng Rd.
Bangkok 10240
Tel: 66 2 374-2516, 374-1632

Turkey
Turk Philips Ticaret A.S.
Inonu Caddesi 78/80
Posta Kutusu 504-Beyoglu
Istanbul
Tel: 90 1 1435891

Uruguay
Coasin Uruguaya S.A
Casilla de Correo 1400
Libertad 2525
Montevideo
Tel: 598-2-789015

Venezuela
Coasin C.A.
Calle 9 Con Calle 4, Edif. Edinurbi
Apartado de Correos Nr-70-136
Los Ruices
Caracas 1070-A
Tel: 58 2 241-0309, 241-1248

West Germany
Philips GmbH
Department VSF
Service fuer FLUKE - Produkte
Oskar - Messter - Strasse 18
D-8045 Ismaning / Munich
Tel: 49 089 9605-260

D9816
Westermann Wilhelm Augusta-Anlage
Mannheim-Nackarau Germany

00199
Marcon Electronics Corp
Kearny, New Jersey

00213
Nytronics Comp. Group Inc.
Darrlingon, South Carolina

00327
Welwyn International Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors Inc.
Passaic, New Jersey

00779
AMP, Inc.
Harrisburg, Pennsylvania

01121
Allen Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronics & Defense Sector
Lawndale, California

01295
Texas Instruments Inc.
Semiconductor Group
Dallas,Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

01686
RCL Electronics/Shallcross Inc.
Electro Components Div.
Manchester, New Hampshire

01884
Sprague Electric Co.
(Now 56289)

01961
Varian Associates Inc.
Pulse Engineering Div.
Convoy, Connecticut

02111
Spectrol Electronics Corp.
City of Industry, California

02114
Amperex Electronic Corp.
Ferrox Cube Div.
Saugerties, New York

02131
General Instrument Corp.Government
Systems Div.
Westwood, Massachusetts

02395
Sonar Radio Corp.
Hollywood, Florida

02533
Leigh Instruments Ltd.
Frequency Control Div.
Don Mills, Ontario, Canada

02606
Fenwal Labs
Division of Travenal Labs
Morton Grove, Illinois

0266
Bunker Ramo-Eltra Corp.
Amphenol NA Div.
Broadview, Illinois

02735
RCA-Solid State Div.
Somerville, New Jersey

02799
Arco Electronics Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products& Batteries
Auburn, New York

03797
Genisco Technology Corp.
Eltronics Div.
Rancho Dominquez, Calif.

03877
Gilbert Engineering Co.Inc
Incon Sub of Transitron
Electronic Corp.
Glendale, Arizona

03888
KDI Electronics Inc.
Pyrofilm Div.
Whippany, New Jersey

03911
Clairex Corp.
Clairex Electronics Div.
Mount Vernon, New York

03980
Muirhead Inc.
Mountainside, New Jersey

04009
Cooper Industries, Inc.
Arrow Hart Div.
Hartford, Connecticut

04217
Essex International Inc.
Wire & Cable Div.
Anaheim, California

04221
Midland-Ross Corp.
Midtex Div.
N. Mankato, Minnesota

04222
AVX Corp.
AVX Ceramics Div.
Myrtle Beach, S. Carolina

04423
Telonic Berkley Inc.
Laguna Beach, California

04713
Motorola Inc.
Semiconductor Group
Phoenix, Arizona

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Corcom Inc.
Libertyville, Illinois

05276
ITT Pomona
Electronics Div.
Pomona, California

05277
Westinghouse Elec. Corp.
Semiconductor Div.
Youngwood, Pennsylvania

05397
Union Carbide Corp.
Materials Systems Div.
Cleveland. Ohio

05571
Sprague Electric Co.
(Now 56289)

05574
Viking Connectors Inc
Sub of Criton Corp.
Chatsworth, Calif.

05820
EG & G Wakefield Engineering
Wakefield, Massachusetts

05972
Loctite Corp.
Newington, Connecticut

06001
General Electric Co.
Electric Capacitor Product Section
Columbia, S. Carolina

06141
Fairchild Weston Systems Inc.
Data Systems Div.
Sarasota, Florida

06192
La Deau Mfg. Co.
Glendale, California

06229
Electrovert Inc.
Elmsford, New York

06383
Panduit Corp.
Tinley Park, Illinois

06473
Bunker Ramo Corp.
Amphenol NA Div.
SAMS Operation
Chatsworth, California

06555
Beede Electrical Instrument
Penacook, New Hampshire

06665
Precision Monolithics
Sub of Bourns Inc.
Santa Clara, California

06666
General Devices Co. Inc.
Indianapolis, Indiana

06739
Electron Corp.
Littleton, Colorado

06743
Gould Inc.
Foil Div.
Eastlake, Ohio

06751
Components Inc.
Semcor Div.
Phoenix, Arizona

06776
Robinson Nugent Inc.
New Albany, Indiana

06915
Richco Plastic Co.
Chicago, Illinois

06961
Vernitron Corp.
Piezo Electric Div.
Bedford, Ohio

06980
Varian Associates Inc.
Eimac Div.
San Carlos, California

07047
Ross Milton Co., The
Southampton, Penna.

07138
Westinghouse Electric Corp.
Industrial & Government
Tube Div.
Horseheads, New York

07233
Benchmark Technology Inc.
City of Industry, Calif.

07239
Biddle Instruments
Blue Bell, Penna.

07256
Silicon Transistor Corp.
Sub of BBF Inc.
Chelmsford, Massachusetts

07261
Avnet Corp.
Culver City, California

07263
Fairchild Camera & Instrument
Semiconductor Div.
Mountain View, California

07344
Bircher Co. Inc., The
Rochester, New York

07557
Campion Co. Inc.
Philadelphia, Penna.

07597
Burndy Corp.
Tape/Cable Div.
Rochester, New York

07716
TRW Inc. (Can use 11502)
IRC Fixed Resistors/
Burlington
Burlington, Iowa

07792
Lerma Engineering Corp.
Northampton, Massachusetts

07810
Bock Corp.
Madison, Wisconsin

07933
Raytheon Co.
Semiconductor Div.
Mountain View, Calif.

08235
Industro Transistor Corp.
Long Island City, New York

08261
Spectra-Strip
An Eltra Co.
Garden Grove, Calif.

08530
Reliance Mica Corp.
Brooklyn, New York

08718
ITT Cannon Electric
Phoenix Div.
Phoenix, Arizona

08806
General Electric Co.
Minature Lamp Products
Cleveland, Ohio

08863
Nylomatic
Fallsington, Penna.

08988
Skottie Electronics Inc.
Archbald, Pennsylvania

09021
Airco Inc.
Airco Electronics
Bradford, Penna.

09023
Cornell-Dublier Electronics
Fuquay-Varina, N. Carolina

09214
General Electric Co.
Semiconductor Products Dept.
Auburn, New York

09353
C and K Components Inc.
Newton, Massachusetts

09423
Scientific Components Inc.
Santa Barbara, California

09579
CTS of Canada, Ltd
Streetsville, Ontario

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc.
Yankton, South Dakota

09975
Burroughs Corp.
Electronics Components
Detroit, Michigan

10059
Barker Engineering Corp.
Kenilworth, New Jersey

10389
Illinois Tool Works Inc.
Licon Div.
Chicago, Illinois

10582
CTS of Asheville
Skyland, N. Carolina

11236
CTS Corp.
Berne Div.
Berne, Indiana

11237
CTS Corp of California
Paso Robles Div.
Paso Robles, California

11295
ECM Motor Co.
Schaumburg, Illinois

11358
Columbia Broadcasting System
CBS Electronic Div.
Newburyport, Massachusetts

11403
Vacuum Can Co.Best Coffee Maker Div.
Chicago, Illinois

11502
TRW Inc.
TRW Resistive Products Div.
Boone, North Carolina

11503
Keystone Columbia Inc.
Freemont, Indiana

11532
Teledyne Relays Teledyne
Industries Inc.
Hawthorne, California

11711
General Instrument Corp.
Rectifier Div.
Hicksville, New York

11726
Qualidyne Corp.
Santa Clara, California

12014
Chicago Rivet & Machine Co.
Naperville, Illinois

12040
National Semiconductor Corp.
Danbury, Connecticut

12060
Diodes Inc.
Northridge, California

12136
PHC Industries Inc.
Formerly Philadelphia Handle Co.
Camden, New Jersey

12300
AMF Canada Ltd.
Potter-Brumfield
Guelph, Ontario, Canada

12323
Practical Automation Inc.
Shelton, Connecticut

12327
Freeway Corp.
Cleveland, Ohio

12443
Budd Co.,The
Plastics Products Div.
Phoenixville, Pennsylvania

12581
Hitachi Metals Inernational Ltd.
Hitachi Magna-Lock Div.
Big Rapids, Missouri

12615
US Terminals Inc.
Cincinnati, Ohio

12617
Hamlin Inc.
Lake Mills, Wisconsin

12697
Clarostat Mfg. Co. Inc.
Dover, New Hampshire

12749
James Electronic Inc.
Chicago, Illinois

12856
MicroMetals Inc.
Anaheim, California

12881
Metex Corp.
Edison, New Jersey

12895
Cleveland Electric Motor Co.
Cleveland, Ohio

12954
Microsemi Corp.
Components Group
Scottsdale, Arizona

12969
Unitrode Corp.
Lexington, Massachusetts

13050
Potter Co.
Wesson, Mississippi

13103
Thermalloy Co., Inc.
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

13511
Bunker-Ramo Corp.
Amphenol Cadre Div.
Los Gatos, California

13606
Sprague Electric Co.
(Use 56289)

13689
SPS Technologies Inc.
Hatfield, Pennsylvania

13919
Burr-Brown Research Corp.
Tucson, Arizona

14099
Semtech Corp.
Newbury Park, California

14140
McGray-Edison Co.
Commercial Development Div.
Manchester, New Hampshire

14193
Cal-R-Inc.
Santa Monica, California

14298
American Components Inc.
an Insilco Co. RPC Div.
Conshohocken, Pennsylvania

14298
ACIC Inc.
Sub of Insilco Corp.
Research Triangle Park, NC

14329
Wells Electronics Inc.
South Bend, Indiana

14482
Watkins-Johnson Co.
Palo Alto, California

14552
Microsemi Corp.
Santa Ana, California

14655
Cornell-Dublier Electronics
Div. of Federal Pacific
Electric Co. Govt Cont Dept.
Newark, New Jersey

14704
Crydom Controls
(Division of Int Rectifier)
El Segundo, California

14752
Electro Cube Inc.
San Gabriel, California

14936
General Instrument Corp.
Discrete Semi Conductor Div.
Hicksville, New York

14949
Trompeter Electronics
Chatsworth, California

15412
Amtron
Midlothian, Illinois

15542
Scientific Components Corp.
Mini-Circuits Laboratory Div.
Brooklyn, New York

15636
Elec-Trol Inc.
Saugus, California

15782
Bausch & Lomb Inc.
Graphics & Control Div.
Austin, Texas

15801
Fenwal Eletronics Inc.
Div. of Kidde Inc.
Framingham, Massachusetts

15818
Teledyne Inc. Co.
Teledyne Semiconductor Div.
Mountain View, California

15849
Useco Inc.
(Now 88245)

15898
International Business
Machines Corp.
Essex Junction, Vermont

16245
Conap Inc.
Olean, New York

16258
Space-Lok Inc.
Burbank, California

16352
Codi Corp.
Linden, New Jersey

16469
MCL Inc.
LaGrange, Illinois

16473
Cambridge Scientific Industries
Div. of Chemed Corp.
Cambridge, Maryland

16733
Cablewave Systems Inc.
North Haven, Connecticut

16742
Paramount Plastics
Fabricators Inc.
Downey, California

16758
General Motors Corp.
Delco Electronics Div.
Kokomo, Indiana

17069
Circuit Structures Lab
Burbank, California

17117
Electronic Molding Corp.
Woonsocket, Rhode Island

17338
High Pressure Eng. Co. Inc.
Oklahoma City, Oklahoma

17545
Atlantic Semiconductors Inc.
Asbury Park, New Jersey

17745
Angstrohm Precision, Inc.
Hagerstown, Maryland

17856
Siliconix Inc.
Santa Clara, California

18178
E G & Gvactee Inc.
St. Louis, Missouri

18324
Signetics Corp.
Sacramento, California

18520
Sharp Electronics Corp.
Paramus, New Jersey

18542
Wabash Inc.
Wabash Relay & Electronics Div.
Wabash, Indiana

18565
Chomerics Inc.
Woburn, Massachusetts

18612
Vishay Intertechnology Inc.
Vishay Resistor Products Group
Malvern, Pennsylvania

18632
Norton-Chemplast
Santa Monica, California

18677
Scanbe Mfg. Co.
Div. of Zero Corp.
El Monte, California

18736
Voltronics Corp.
East Hanover, New Jersey

18927
GTE Products Corp.
Precision Material Products
Business Parts Div.
Titusville, Pennsylvania

19315
Bendix Corp., The
Navigation & Control Group
Terboro, New Jersey

19451
Perine Machinery & Supply Co..
Kent, Washington

19613
Minnesota Mining & Mfg. Co.
Textool Products Dept.
Electronic Product Div.
Irving, Texas

19647
Caddock Electronics Inc.
Riverside, California

19701
Mepco/Centralab Inc.
A N. American Philips Co.
Mineral Wells, Texas

20584
Enochs Mfg. Inc.
Indianapolis, Indiana

20891
Cosar Corp.
Dallas, Texas

21317
Electronics Applications Co.
El Monte, California

21604
Buckeye Stamping Co.
Columbus, Ohio

21845
Solitron Devices Inc.
Semiconductor Group
Rivera Beach, Florida

22526
DuPont, El DeNemours & Co. Inc.
DuPont Connector Systems
Advanced Products Div.
New Cumberland, Pennsylvania

22767
ITT Semiconductors
Palo Alto, California

22784
Palmer Inc.
Cleveland, Ohio

23050
Product Comp. Corp.
Mount Vernon, New York

23732
Tracor Applied Sciences Inc.
Rockville, Maryland

23880
Stanford Applied Engineering
Santa Clara, California

23936
William J. Purdy Co.
Pamotor Div.
Burlingame, California

24347
Penn Engineering Co.
S. El Monte, California

24355
Analog Devices Inc.
Norwood, Massachusetts

24444
General Semiconductor
Industries, Inc.
Tempe, Arizona

24655
Genrad Inc.
Concord, Massachusetts

24759Lenox-Fugle Electronics Inc.
South Plainfield, New Jersey

24796
AMF Inc.
Potter & Brumfield Div.
San Juan Capistrano, Calif.

24931
Specialty Connector Co.
Greenwood, Indiana

25088
Siemen Corp.
Isilen, New Jersey

25099
Cascade Gasket
Kent, Washington

25403
Amperex Electronic Corp.
Semiconductor & Micro-Circuit Div.
Slatersville, Rhode Island

25706
Dabum Electronic & Cable Corp.
Norwood, New Jersey

26629
Frequency Sources Inc.
Sources Div.
Chelmsford, Massachusetts

26806
American Zettler Inc.
Irvine, California

27014
National Semiconductor Corp.
Santa Clara, California

27167
Corning Glass Works Corning
Electronics
Wilmington, North Carolina

27264
Molex Inc.
Lisle, Illinois

27440
Industrial Screw Products
Los Angeles, California

27745
Associated Spring Barnes Group Inc.
Syracuse, New York

27956
Relcom (Now 14482)

28198
Positronic Industries
Springfield, Missouri

28213
Minnesota Mining & Mfg. Co.
Consumer Products Div.
3M Center
Saint Paul, Minnesota

28425
Serv-O-Link
Euless, Texas

28478
Deltrol Corporation
Deltrol Controls Div.
Milwaukee, Wisconsin

28480
Hewlett Packard Co.
Corporate HQ
Palo Alto, California

28484
Emerson Electric Co.
Gearmaster Div.
McHenry, Illinois

28520
Heyco Molded Products
Kenilworth, New Jersey

29083
Monsanto Co.
Santa Clara, California

29604
Stackpole Components Co.
Raleigh, North Carolina

29907
Omega Engineering Inc.
Stamford, Connnecticut

30035
Jolo Industries Inc.
Garden Grove, California

30146
Symbex Corp.
Painesville, Ohio

30148
AB Enterprise Inc.
Ahoskie, North Carolina

30161
Aavid Engineering Inc.
Laconia, New Hampshire

30315
Itron Corp.
San Diego, California

30323
Illinois Tool Works Inc.
Chicago, Illinois

30800
General Instrument Corp.
Capacitor Div.
Hicksville, New York

31019
Solid State Scientific Inc.
Willow Grove, Pennsylvania

31091
Alpha Industries Inc.
Microelectronics Div.
Hatfield, Pennsylvania

31323
Metro Supply Company
Sacramento, California

31448
Army Safeguard Logistics Command
Huntsville, Alabama

31746
Cannon Electric
Woodbury, Tennessee

31827
Budwig
Ramona, California

31918
ITT-Schadow
Eden Prairie, Minnesota

32293
Intersil
Cupertino, California

32539
Mura Corp.
Westbury, Long Island, N.Y.

32559
Bivar
Santa Ana, California

32767
Griffith Plastics Corp.
Burlingame, California

32879
Advanced Mechanical Components
Northridge, California

32897
Murata Erie North America Inc.
Carlisle Operations
Carlisle, Pennsylvania

32997
Bourns Inc.
Trimpot Div.
Riverside, California

33096
Colorado Crystal Corp.
Loveland, Colorado

33173
General Electric Co.
Owensboro, Kentucky

33246
Epoxy Technology Inc.
Billerica, Massachusetts

33297
NEC Electronics USA Inc.
Electronic Arrays Inc. Div.
Mountain View, California

33919
Nortek Inc.
Cranston, Rhode Island

34333
Silicon General Inc.
Garden Grove, California

34225
Advanced Micro Devices
Sunnyvale, California

34359
Minnesota Mining & Mfg. Co.
Commercial Office Supply Div.
Saint Paul, Minnesota

34371
Harris Corp.
Harris Semiconductor
Products Group
Melbourne, Florida

34649
Intel Corp.
Santa Clara, California

34802
Electromotive Inc.
Kenilworth, New Jersey

34848
Hartwell Special Products
Placentia, California

35009
Renfrew Electric Co. Ltd.
IRC Div.
Toronto, Ontario, Canada

36665
Mitel Corp.
Kanata, Ontario, Canada

37942
Mallory Capacitor Corp.
Sub of Emhart Industries
Indianapolis, Indiana

39003
Maxim Industries
Middleboro, Massachusetts

40402
Roderstein Electronics Inc.
Statesville, North Carolina

42498
National Radio
Melrose, Massachusetts

43543
Nytronics Inc.(Now 53342)

44655
Ohmite Mfg. Co.
Skokie, Illinois

49671
RCA Corp.
New York, New York

49956
Raytheon Company
Executive Offices
Lexington, Massachusetts

50088
Thomson Components-Mostek Corp.
Carrollton, Texas

50120
Eagle-Picher Industries Inc.
Electronics Div.
Colorado Springs, Colorado

50157
Midwest Components Inc.
Muskegon, Mississippi

50541
Hypertronics Corp.
Hudson, Massachusetts

50579
Litronix Inc.
Cupertino, California

51167
Aries Electronics Inc.
Frenchtown, New Jersey

51372
Verbatim Corp.
Sunnyvale, California

51406
Murata Erie, No. America Inc.
(Also see 72982)
Marietta, Georgia

51499
Amtron Corp.
Boston, Massachusetts

51605
CODI Semiconductor Inc.
Kenilworth, New Jersey

51642
Centre Engineering Inc.
State College, Pennsylvania

51791
Statek Corp.
Orange, California

51984
NEC America Inc.
Falls Church, Virginia

52063
Exar Integrated Systems
Sunnyvale, California

52072
Circuit Assembly Corp.
Irvine, California

52152
Minnesota Mining & Mfg.
Saint Paul, Minnesota

52333
API Electronics
Haugpauge,Long Island,New York

52361
Communication Systems
Piscataway, New Jersey

52525
Space-Lok Inc.
Lerco Div.
Burbank, California

52531
Hitachi Magnetics
Edmore, Missouri

52745
Timco
Los Angeles, California

52763
Stettner-Electronics Inc.
Chattanooga, Tennessee

52769
Sprague-Goodman Electronics Inc.
Garden City Park, New York

52771
Moniterm Corp.
Amatrom Div.
Santa Clara, California

52840
Western Digital Corp.
Costa Mesa, California

53021
Sangamo Weston Inc.
(See 06141)

53217
Technical Wire Products Inc.
Santa Barbara, California

53342
Opt Industries Inc.
Phillipsburg, New Jersey

53944
Glow-Lite
Pauls Valley, Oklahoma

54294
Shallcross Inc.
Smithfield, North Carolina

54453
Sullins Electronic Corp.
San Marcos, California

54473
Matsushita Electric Corp.
(Panasonic)
Secaucus, New Jersey

54583
TDK
Garden City, New York

54869
Piher International Corp.
Arlington Heights, Illinois

54937
DeYoung Mfg.
Bellevue, Washington

54590
RCA Corp.
Electronic Components Div.
Cherry Hill, New Jersey

55026
American Gage & Machine Co.
Simpson Electric Co. Div.
Elgin, Illinois

55112
Plessey Capacitors Inc.
(Now 60935)

55261
LSI Computer Systems Inc.
Melville, New York

55285
Bercquist Co.
Minneapolis, Minnesota

55576
Synertek
Santa Clara, California

55680
Michicon/America/Corp.
Schaumburg, Illinois

56282
Utek Systems Inc.
Olathe, Kansas

56289
Sprague Electric Co.
North Adams, Massachusetts

56365
Square D Co.
Corporate Offices
Palatine, Illinois

56375
DAL Industries Inc.
Wescorp Div.
Mountain View, California

56481
Shugart Associates
Sub of Xerox Corp.
Sunnyvale, California

56708
Zilog Inc.
Campbell, California

56856
Vamistor Corp. of Tennessee
Sevierville, Tennessee

56880
Magnetics Inc.
Baltimore, Maryland

57026
Endicott Coil Co. Inc.
Binghamton, New York

57053
Gates Energy Products
Denver, Ohio

58014
Hitachi Magnalock Corp.
(Now 12581)

58104
Simco
Atlanta, Georgia

58474
Superior Electric Co.
Bristol, Connecticut

59124
KOA-Speer Electronics Inc.
Bradford, Pennsylvania

59640
Supertex Inc.
Sunnyvale, California

59660
Tusonix Inc.
Tucson, Arizona

59730
Thomas and Betts Corp.
Iowa City, Iowa

59831
Semtronics Corp.
Watchung, New Jersey

60395
Xicor Inc.
Milpitas, California

60399
Torin Engineered Blowers
Div. of Clevepak Corp.
Torrington, Connecticut

60705
Cera-Mite Corp.
(formerly Sprague)
Grafton, Wisconsin

60935
Westlake Capacitor Inc.
Tantalum Div.
Greencastle, Indiana

61804
M/A Com Inc.
Burlington, Massachusetts

61857
SAN-O Industrial Corp.
Bohemia, Long Island, NY

61935
Schurter Inc.
Petaluma, California

62351
Apple Rubber
Lancaster, New York

62793
Lear Siegler Inc.
Energy Products Div.
Santa Ana, California

63743
Ward Leonard Electric Co.Inc.
Mount Vernon, New York

64154
Lamb Industries
Portland, Oregon

64155
Linear Technology
Milpitas, California

64834
West M G Co.
San Francisco, Calif.

65092
Sangamo Weston Inc.
Weston Instruments Div.
Newark, New Jersey

65940
Rohm Corp & Whatney
Irvine, California

65964
Evox Inc.
Bannockburn, Illinois

66150
Entron Inc.
Winslow Teltronics Div.
Glendale, New York

66608
Bering Industries
Fremont, California

70290
Almetal Universal Joint Co.
Cleveland, Ohio

70485
Atlantic India Rubber Works Inc.
Chicago, Illinois

70563
Amperite Company
Union City, New Jersey

70903
Belden Corp.
Geneva, Illinois

71002
Birnbach Co. Inc.
Farmingdale, New York

71034
Bliley Electric Co.
Erie, Pennsylvania

71183
Westinghouse Electric Corp.
Bryant Div.
Bridgeport, Connecticut

71400
Bussman Manufacturing
Div. McGraw-Edison Co.
St. Louis, Missouri

71450
CTS Corp.
Elkhart, Indiana

71468
ITT Cannon Div. of ITT
Fountain Valley, California

71482
General Instrument Corp.
Clare Div.
Chicago, Illinois

71590
Mepco/Centralab
A North American Philips Co.
Fort Dodge, Iowa

71707
Coto Corp.
Providence, Rhode Island

71744
General Instrument Corp.
Lamp Div/Worldwide
Chicago, Illinois

71785
TRW Inc.
Cinch Connector Div.
Elk Grove Village, Illinois

71984
Dow Corning Corp.
Midland, Michigan

72005
AMAX Specialty Metals Corp.
Newark, New Jersey

72136
Electro Motive Mfg. Corp.
Florence, South Carolina

72228
AMCA International Corp.
Continental Screw Div.
New Bedford, Massachusetts

72259
Nytronics Inc.
New York, New York

72619
Amperex Electronic Corp.
Dialight Div.
Brooklyn, New York

72653
G C Electronics Co.
Div. of Hydrometals Inc.
Rockford, Illinois

72794
Dzus Fastner Co. Inc.
West Islip, New York

72928
Gulton Industries Inc.
Gudeman Div.
Chicago, Illinois

72982
Murata Erie N. America Inc.
Erie, Pennsylvania

73138
Beckman Industrial corp.
Helipot Div.
Fullerton, California

73168
Fenwal Inc.
Ashland, Massachusetts

73293
Hughes Aircraft Co.
Electron Dynamics Div.
Torrance, California

73445
Amperex Electronic Corp.
Hicksville, New York

73559
Carlingswitch Inc.
Hartford, Connecticut

73586
Circle F Industries
Trenton, New Jersey

73734
Federal Screw Products Inc.
Chicago, Illinois

73743
Fischer Special Mfg. Co.
Cold Spring, Kentucky

73893
Microdot
Mt. Clemens, Mississippi

73899
JFD Electronic Components
Div. of Murata Erie
Oceanside, New York

73905
FL Industries Inc.
San Jose, California

73949
Guardian Electric Mfg. Co.
Chicago, Illinois

74199
Quam Nichols Co.
Chicago, Illinois

74217
Radio Switch Co.
Marlboro, New Jersey

74306
Piezo Crystal Co.
Div. of PPA Industries Inc.
Carlisle, Pennsylvania

74542
Hoyt Elect.Instr. Works Inc.
Penacook, New Hampshire

74840
Illinois Capacitor Inc.
Lincolnwood, Illinois

74970
Johnson EF Co.
Waseca, Minnesota

75042
TRW Inc.
IRC Fixed Resistors
Philadelphia, Pennsylvania

75297
Litton Systems
Kester Solder Div.
Chicago, Illinois

75376
Kurz-Kasch Inc.
Dayton, Ohio

75378
CTS Knights Inc.
Sandwich, Illinois

75382
Kulka Electric Corp.
(Now 83330)
Mount Vernon, New York

75915
Tracor Littlefuse
Des Plaines, Illinois

76854
Oak Switch Systems Inc.
Crystal Lake, Illinois

77122
TRW Assemblies & Fasteners Group
Fastener Div.
Moutainside, New Jersey

77342
AMF Inc.
Potter & Brumfield Div.
Princeton, Indiana

77542
Ray-O-Vac Corp
Madison, Wisconsin

77638
General Instrument Corp.
Rectifier Div.
Brooklyn, New York

77900
Shakeproof Lock Washer Co.
(Now 78189)

77969
Rubbercraft Corp. of CA Ltd.
Torrance, California

78189
Illinois Tool Works Inc.
Shakeproof Div.
Elgin, Illinois

78277
Sigma Instruments Inc.
South Braintree, Mass.

78290
Struthers Dunn Inc.
Pitman, New Jersey

78553
Eaton Corp.
Engineered Fastener Div.
Cleveland, Ohio

78592
Stoeger Industries
South Hackensack, New Jersey

79136
Waldes Kohinoor Inc.
Long Island City, New York

79497
Western Rubber Co.
Goshen, Indiana

79727
C - W Industries
Southampton, Pennsylvania

79963
Zierick Mfg. Corp.
Mount Kisco, New York

80009
Tektronix
Beaverton, Oregon

80031
Mepco/Electra Inc.
Morristown, New Jersey

80032
Ford Aerospace & Communications Corp.
Western Development
Laboratories Div.
Palo Alto, California

80145
LFE Corp.
Process Control Div.
Clinton, Ohio

80183
Sprague Products
(Now 56289)

80294
Bourns Instruments Inc.
Riverside, California

80583
Hammerlund Mfg. Co. Inc.
Paramus, New Jersey

80640
Computer Products Inc.
Stevens-Arnold Div.
South Boston, Mass.

81073
Grayhill Inc.
La Grange, Illinois

81312
Litton Systems Inc.
Winchester Electronics Div.
Watertown, Connecticut

81439
Therm-O-Disc Inc.
Mansfield, Ohio

81483
International Rectifier Corp.
Los Angeles, California

81590
Korry Electronics Inc.
Seattle, Washington

81741
Chicago Lock Co.
Chicago, Illinois

82227
Airpax Corp.
Cheshire Div.
Cheshire, Connecticut

82240
Simmons Fastner Corp.
Albany, New York

82305
Palmer Electronics Corp.
South Gate, California

82389
Switchcraft Inc.
Sub of Raytheon Co.
Chicago, Illinois

82415
Airpax Corp
Frederick Div.
Frederick, Maryland

82872
Roanwell Corp.
New York, New York

82877
Rotron Inc.
Custom Div.
Woodstock, New York

82879
ITT
Royal Electric Div.
Pawtucket, Rhode Island

83003
Varo Inc.
Garland, Texas

83014
Hartwell Corp.
Placentia, California

83055
Signalite Fuse Co.
(Now 71744)

83058
TRW Assemblies & Fasteners Group
Fasteners Div.
Cambridge, Massachusetts

83259
Parker-Hannifin Corp.
O-Seal Div.
Culver City, California

83298
Bendix Corp.
Electric & Fluid Power Div.
Eatonville, New Jersey

83315
Hubbell Corp.
Mundelein, Illinois

83330
Kulka Smith Inc.
A North American Philips Co.
Manasquan, New Jersey

83478
Rubbercraft Corp. of America
West Haven, Connecticut

83553
Associated Spring Barnes Group
Gardena, California

83740
Union Carbide Corp.
Battery Products Div.
Danbury, Connecticut

84171
Arco Electronics
Commack, New York

84411
American Shizuki
TRW Capacitors Div.
Ogallala, Nebraska

84613
FIC Corp.
Rockville, Maryland

84682
Essex Group Inc.
Peabody, Massachusetts

85367
Bearing Distributing Co.
San Fransisco, California

85372
Bearing Sales Co.
Los Angeles, California

85480
W. H. Brady Co.
Industrial Product
Milwaukee, Wisconsin

85932
Electro Film Inc.
Valencia, California

86577
Precision Metal Products Co.
Peabody, Massachusetts

86684
Radio Corp. of America
(Now 54590)

86928
Seastrom Mfg. Co. Inc.
Glendale, California

87034
Illuminated Products Inc.
(Now 76854)

88219
GNB Inc.
Industrial Battery Div.
Langhorne, Pennsylvania

88245
Winchester Electronics
Litton Systems-Useco Div.
Van Nuys, California

88486
Triangle PWC Inc.
Jewitt City, Connecticut

88690
Essex Group Inc.
Wire Assembly Div.
Dearborn, Michigan

89020
Amerace Corp.
Buchanan Crimptool Products Div.
Union, New Jersey

89265
Potter-Brumfield
(See 77342)

89536
John Fluke Mfg. Co., Inc.
Everett, Washington

89597
Fredericks Co.
Huntingdon Valley, Penna.

89709
Bunker Ramo-Eltra Corp.
Amphenol Div.
Broadview, Illinois

89730
General Electric
Lamp Div.
Newark, New Jersey

90201
Mallory Capacitor Co.
Sub of Emhart Industries Inc.
Indianapolis, Indiana

90215
Best Stamp & Mfg. Co.
Kansas City, Missouri

90303
Duracell Inc.
Technical Sales & Marketing
Bethel, Connecticut

91094
Essex Group Inc.
Suflex/IWP Div.
Newmarket, New Hampshire

91247
Illinois Transformer Co.
Chicago, Illinois

91293
Johanson Mfg. Co.
Boonton, New Jersey

91462
Alpha Industries Inc.
Logansport, Indiana

91502
Associated Machine
Santa Clara, California

91506
Augat Inc.
Attleboro, Massachusetts

91507
Froeliger Machine Tool Co.
Stockton, California

91637
Dale Electronics Inc.
Columbus, Nebraska

91662
Elco Corp.
A Gulf Western Mfg. Co.
Connector Div.
Huntingdon, Pennsylvania

91737
ITT Cannon/Gremar
(Now 08718)

91802
Industrial Devices Inc.
Edgewater, New Jersey

91833
Keystone Electronics Corp.
New York, New York

91836
King's Electronics Co. Inc.
Tuckahoe, New York

91929
Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934
Miller Electric Co.
Woonsocket, Rhode Island

91984
Maida Development Co.
Hampton, Virginia

91985
Norwalk Valve Co.
S. Norwalk, Connecticut

92914
Alpha Wire Corp.
Elizabeth, New Jersey

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

94144
Raytheon Co.
Microwave & Power Tube Div.
Quincy, Massachusetts

94222
Southco Inc.
Concordville, Pennsylvania

94988
Wagner Electric Corp.
Sub of Mcgraw-Edison Co.
Whippany, New Jersey

95146
Alco Electronic Products Inc.
Switch Div.
North Andover, Massachusetts

95263
Leecraft Mfg. Co.
Long Island City, New York

95275
Vitramon Inc.
Bridgeport, Connecticut

95303
RCA Corp.
Receiving Tube Div.
Cincinnati, Ohio

95348
Gordo's Corp.
Bloomfield, New Jersey

95354
Methode Mfg. Corp.
Rolling Meadows, Illinois

95573
Campion Laboratories Inc.
Detroit, Michigan

95712
Bendix Corp.
Electrical Comp. Div.
Franklin, Indiana

95987
Weckesser Co. Inc.
(Now 85480)

96733
SFE Technologies
San Fernando, California

96853
Gulton Industries Inc.
Measurement & Controls Div.
Manchester, New Hampshire

96881
Thomson Industries Inc.
Port Washington, New York

97525
EECO Inc.
Santa Ana, California

97540
Whitehall Electronics Corp.
Master Mobile Mounts Div.
Fort Meyers, Florida

97913
Industrial Electronic
Hardware Corp.
New York, New York

97945
Pennwalt Corp.
SS White Industrial Products
Piscataway, New Jersey

97966
CBS
Electronic Div.
Danvers, Massachusetts

98094
Machlett Laboratories Inc.
Santa Barbara. California

98159
Rubber-Teck Inc.
Gardena, California

98278
Malco A Microdot Co.
South Pasadena, California

98291
Sealectro Corp.
BICC Electronics
Trumbill, Connecticut

98372
Royal Industries Inc.(Now 62793)

98388
Lear Siegler Inc.
Accurate Products Div.
San Deigo, California

99120
Plastic Capacitors Inc.
Chicago, Illinois

99217
Bell Industries Inc.
Elect. Distributor Div.
Sunnyvale, California

99378
ATLEE of Delaware Inc.
N. Andover, Massachusetts

99392
Mepco/Electra Inc.
Roxboro Div.
Roxboro, North Carolina

99515
Electron Products Inc.
Div. of American Capacitors
Duarte, California

99779
Bunker Ramo- Eltra Corp.
Barnes Div.
Lansdown, Pennsylvania

99800
American Precision Industries
Delevan Div.
East Aurora, New York

99942
Mepco/Centralab
A North American Philips Co.
Milwaukee, Wisconsin

Table 4-7. Manual Status Information, Model 83

REF OR OPTION NO.	ASSEMBLY NAME	FLUKE PART NO.	X = The PCA revision levels documented in this manual.																			
			–	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P			
A1	Main PCA	819284						X														

* X = The PCA revision levels documented in this manual.

Table 4-8. Manual Status Information, Model 85

REF OR OPTION NO.	ASSEMBLY NAME	FLUKE PART NO.	X = The PCA revision levels documented in this manual.																			
			–	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P			
A1	Main PCA	819276						X														

* X = The PCA revision levels documented in this manual.

Table 4-9. Manual Status Information, Model 87

REF OR OPTION NO.	ASSEMBLY NAME	FLUKE PART NO.	X = The PCA revision levels documented in this manual.																			
			–	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P			
A1	Main PCA	819268								X												

* X = The PCA revision levels documented in this manual.

Section 5
Schematic Diagrams

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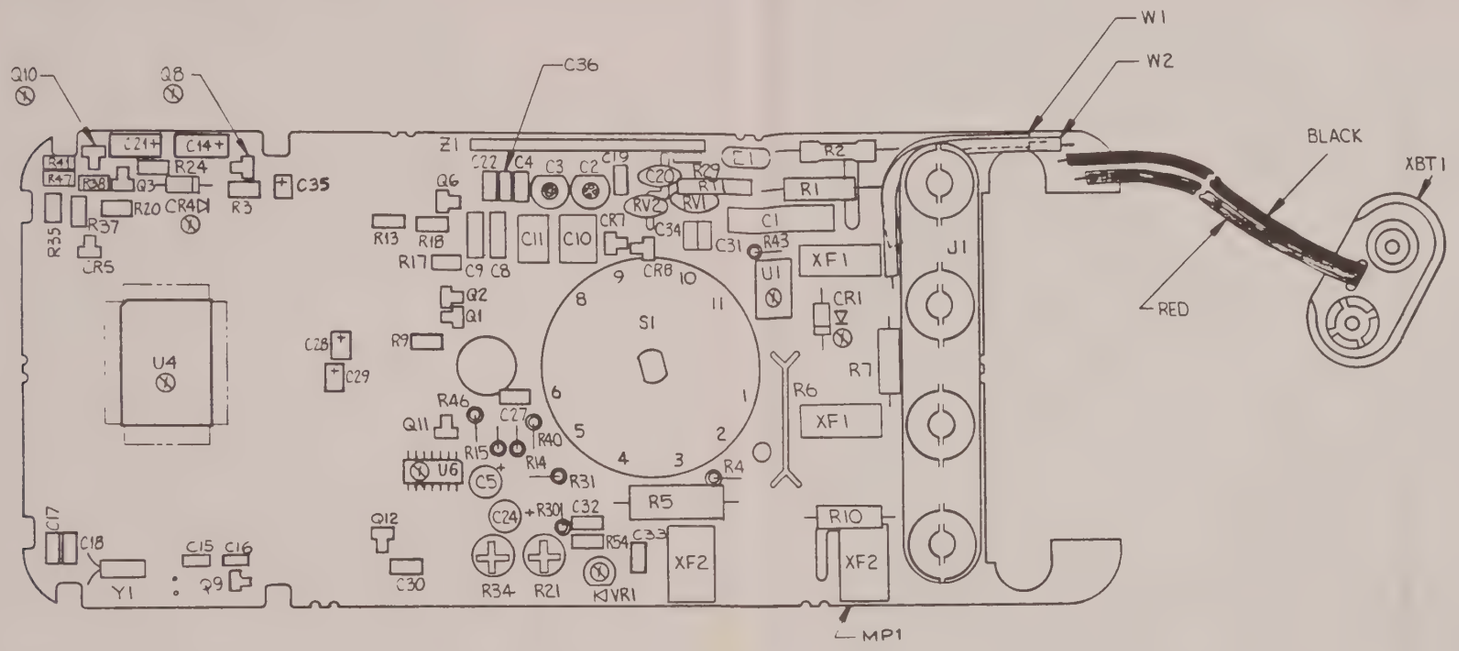
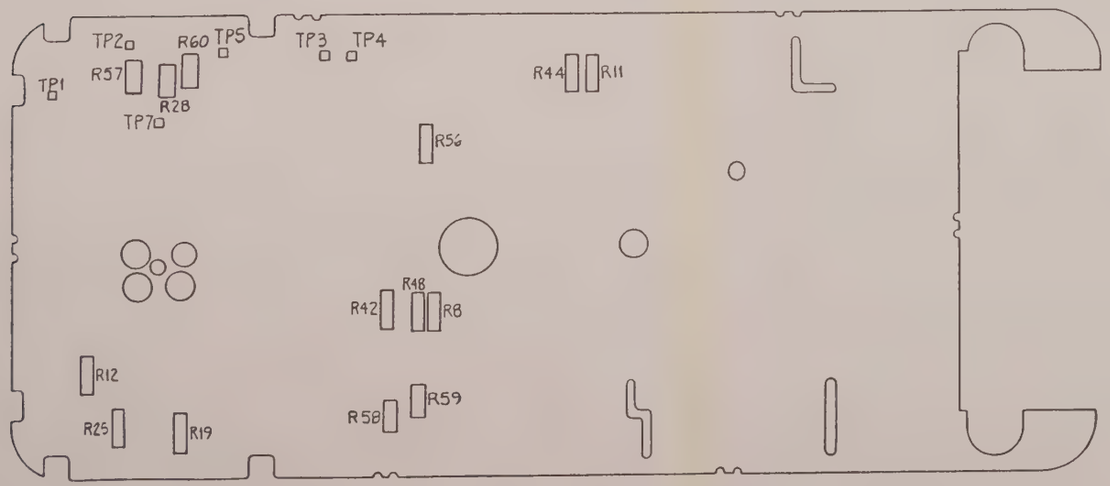
Table 5-1. Signal Abbreviations

ACBM	AC Buffer Minus (inverting input)	K1	Buffer output times 1
ACBO	AC Buffer Output	K2	Buffer output times 10
AFI	Active Filter Input	PDS	Power Down (off) Signal
AFO	Active Filter Output	P00	Port 00 (keypad)
AGND	Analog Ground	P01	Port 01 (keypad)
AP0	Analog Port 0 (guard)	P02	Port 02 (keypad)
AP1	Analog Port 1 (ohms, millivolts sense)	P03	Port 03 (PTF reference and position change sense)
AP2	Analog Port 2 (ohms reference sense)	P10	Port 10 (keypad)
AP3	Analog Port 3 (amps sense)	P11	Port 11 (keypad)
AP4	Analog Port 4 (milli/micro amps jack sense)	P12	Port 12 (keypad)
AP5	Analog Port 5 (amps jack sense)	P13	Port 13 (PW2, RMS power down drive)
AP6	Analog Port 6 (PTF position sense)	PS0	Power Supply 0 (feed back for VDD regulator)
AP7	Analog Port 7 (peak hold min sense)	PS1	Power Supply 1 (feed back for common regulator)
AP8	Analog Port 8 (peak hold max sense)	PS2	Power Supply 2 (output for common regulator)
APV0	Analog Port Voltage 0 (divider input)	PW2	Power 2 (power down drive for RMS converter)
APV1	Analog Port Voltage 1 (divide by 10)	REFH	Reference High (1.23V)
APV2	Analog Port Voltage 2 (divide by 100)	REFI	Reference In (1.00V)
APV3	Analog Port Voltage 3 (divide by 1000)	RESET	Reset for μP
APV4	Analog Port Voltage 4 (divide by 10000)	S0	LCD Segment drive 0
APCC	Analog Port Compensation Capacitor	⋮	
AVAM	Absolute Value Amplifier Minus (inverting input)		
AVAOM	Absolute Value Amplifier Output Minus	S31	LCD Segment drive 31
AVAOP	Absolute Value Amplifier Output Positive	TEST	Factory Test
AZ	Auto Zero	VBT+	Plus battery voltage
CK1	Clock 1 (RC clock output)	VBT-	Minus battery voltage
CK2	Clock 2 (RC clock input)		
COM	Common	VDD	Plus system supply
FAI	Filter Active Input	VDGND	Digital Ground
FAO	Filter Active Output	VOA	2/3 voltage for LCD drive
H1	LCD backplane drive 1	VOB	1/3 voltage for LCD drive
H2	LCD backplane drive 2	VSS	Minus system supply
H3	LCD backplane drive 3		
H4	LCD backplane drive 4		
INT	Integrator output		
K0	Buffer output times .874		



TOP SIDE



BOTTOM SIDE

83-4001

Figure 5-1. Fluke 83 A1 Main PCA

NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL CAPACITANCES ARE IN MICROFARADS. TANTALUMS ARE ±20%. ALL OTHERS ARE ±10%.
2. ALL RESISTANCES ARE IN OHMS. ALL RESISTORS ARE 1/8W, ±5%, CERMET. ±.25% & ±1% RESISTORS ARE 1/8W.

4 R1 IS A FUSIBLE RESISTOR. TO ENSURE SAFETY, USE EXACT REPLACEMENT ONLY.

AVERAGE A/C CONVERTER

REFERENCE

POWER SUPPLY

CURRENT SIGNAL CONDITIONING

VOLTAGE & OHMS SIGNAL CONDITIONING

VOLTAGE & OHMS INPUT PROTECTION

MF	DESIGNATES MYLAR FILM CAPACITOR
C	DESIGNATES CERAMIC CAPACITOR
T	DESIGNATES TANTALUM CAPACITOR
MG	DESIGNATES METAL GLAZE RESISTOR
WW	DESIGNATES WIRE WOUND RESISTOR
MF	DESIGNATES METAL FILM RESISTOR
PC	DESIGNATES POLYCARBONATE CAPACITOR
M	DESIGNATES MYLAR/POLYESTER
PP	DESIGNATES POLYPROPYLENE FILM

	LAST USED	NOT - USED
U	6	2,3,4,5
R	60	1,6,22,23,32,33,34,45,49,50,51,52,53,54,55,56,57
C	38	6,7,11,12,13,25,26
Q	13	4,5,7
CR	8	2,3,6
S	3	
RV	2	
F	2	
TP	7	
RT	1	
J	4	

ROTARY SWITCH INFORMATION

POSITION	FRONT	REAR	TEST ROTARY SWITCH** ±12 COUNTS
OFF		1-2*	
ACV		1-2	0
DCV	3-4	1-2	32
mVDC	3-4, 11-12		64
Ω	3-4-5, 11-12		96
⊣▷	4-6, 11-12	1-2	128
mA/A		9-8, 1-2*	160
μA	3-4*	10-9	192

* CONNECTION NOT USED FOR OPERATION
** POWER UP OPTION. PRESS RANGE BUTTON DOWN FOR 2 SECS WHILE TURNING ON METER

83-1201 (1 of 2)

Figure 5-1. Fluke 83 A1 Main PCA (cont)

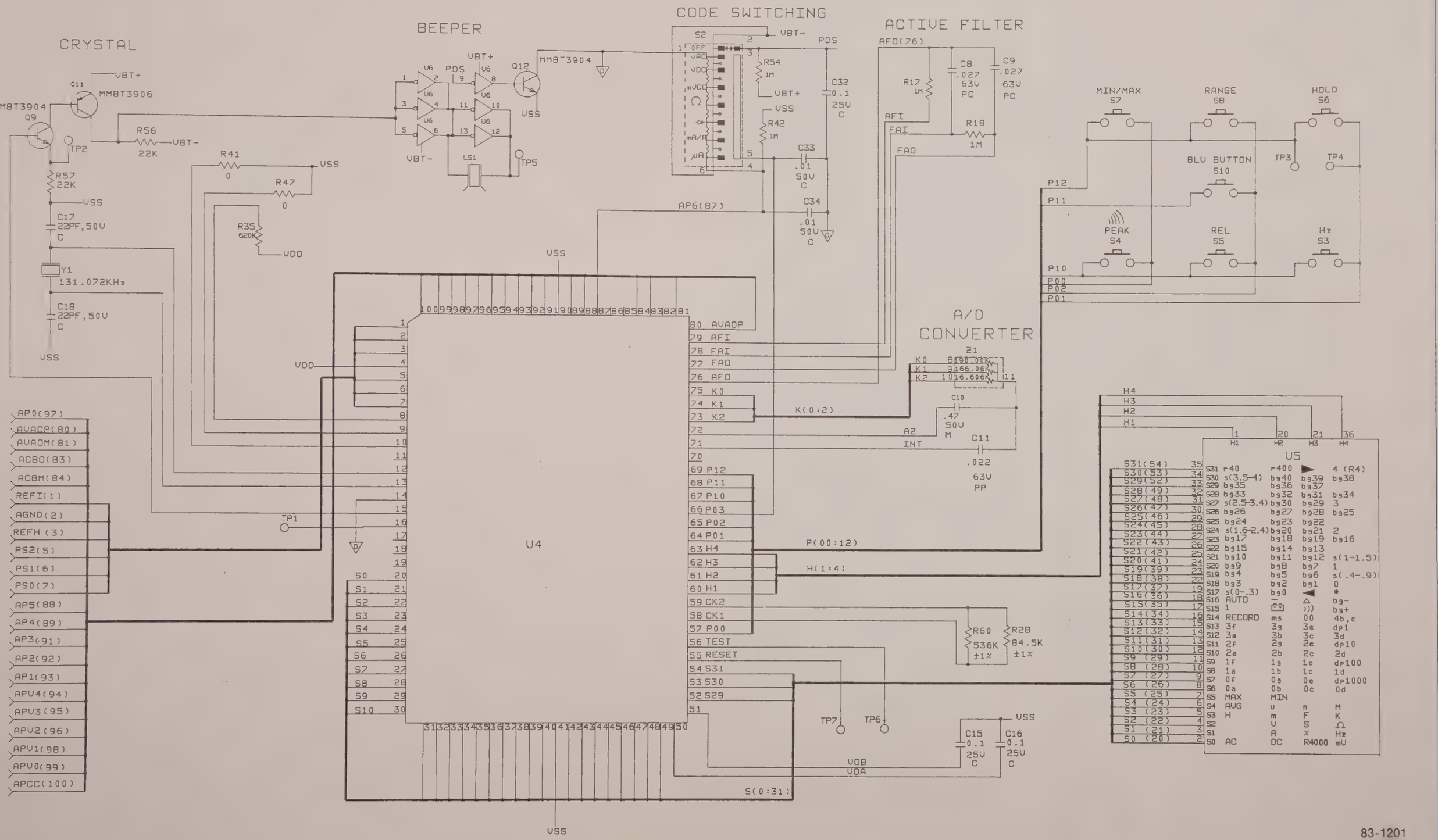
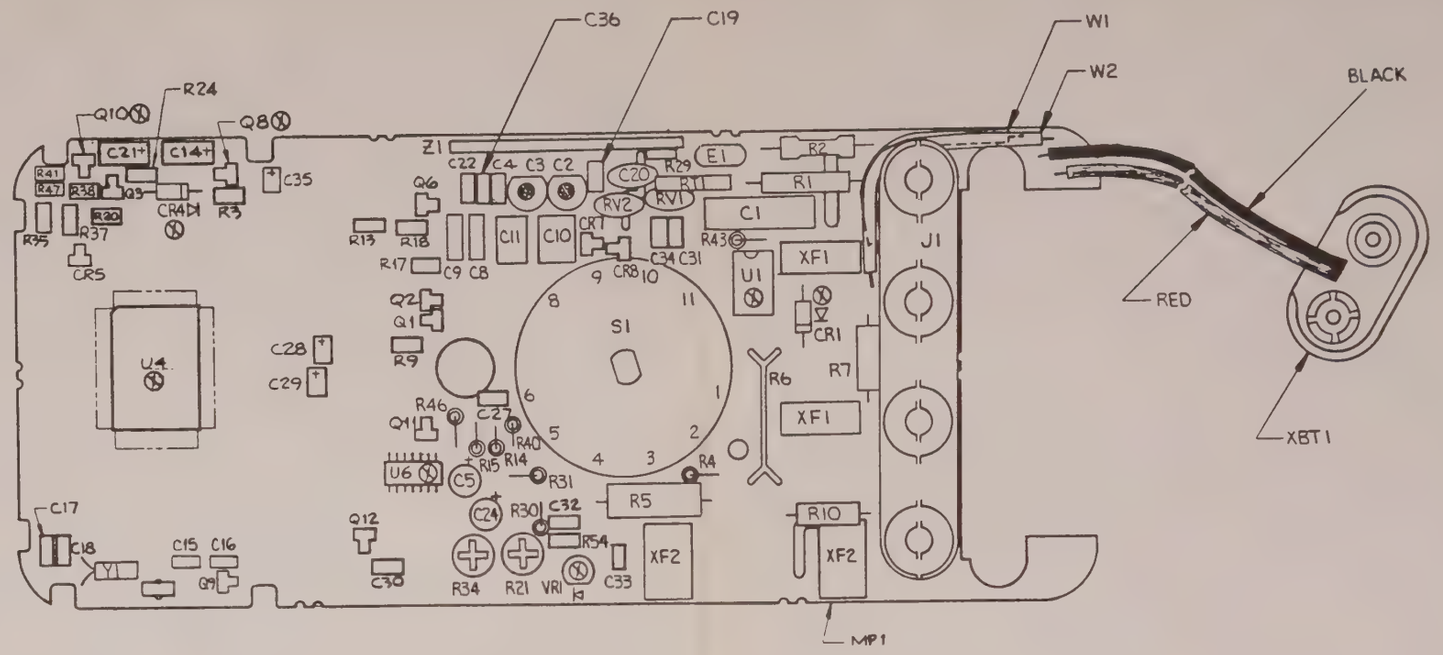
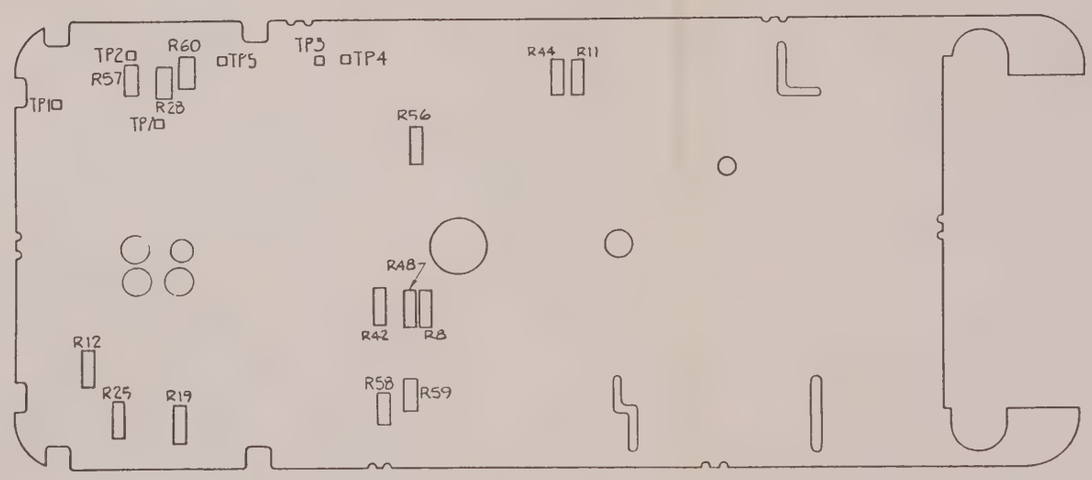


Figure 5-1. Fluke 83 A1 Main PCA (cont)



TOP SIDE



BOTTOM SIDE

85-4001

Figure 5-2. Fluke 85 A1 Main PCA

NOTES: UNLESS OTHERWISE SPECIFIED:

1. ALL CAPACITANCES ARE IN MICROFARADS. TANTALUMS ARE ±20%. ALL OTHERS ARE ±10%.
2. ALL RESISTANCES ARE IN OHMS. ALL RESISTORS ARE 1/8W, ±5% CERMET. ±.25% & ±1% RESISTORS ARE 1/8W.

4 R1 IS A FUSIBLE RESISTOR. TO ENSURE SAFETY, USE EXACT REPLACEMENT ONLY.

MF	DESIGNATES MYLAR FILM CAPACITOR
C	DESIGNATES CERAMIC CAPACITOR
T	DESIGNATES TANTALUM CAPACITOR
MG	DESIGNATES METAL GLAZE RESISTOR
WW	DESIGNATES WIRE WOUND RESISTOR
MF	DESIGNATES METAL FILM RESISTOR
PC	DESIGNATES POLYCARBONATE CAPACITOR
M	DESIGNATES MYLAR/POLYESTER
PP	DESIGNATES POLYPROPYLENE FILM

AVERAGE A/C CONVERTER

REFERENCE

POWER SUPPLY

CURRENT SIGNAL CONDITIONING

VOLTAGE & OHMS SIGNAL CONDITIONING

VOLTAGE & OHMS INPUT PROTECTION

AVAOP(80)
AVAM(82)
AVAOM(81)
ACBO(83)
ACBM(84)
AP0(97)
REFI(1)
AGND(2)
REFH(3)
PS2(5)
VDD
VSS
PS1(6)
VBT+
PS0(7)
AP5(88)
AP4(89)
AP3(91)
AP1(93)
AP2(92)
APV4(94)
APV3(95)
APV2(96)
APV1(98)
APV0(99)
APCC(100)

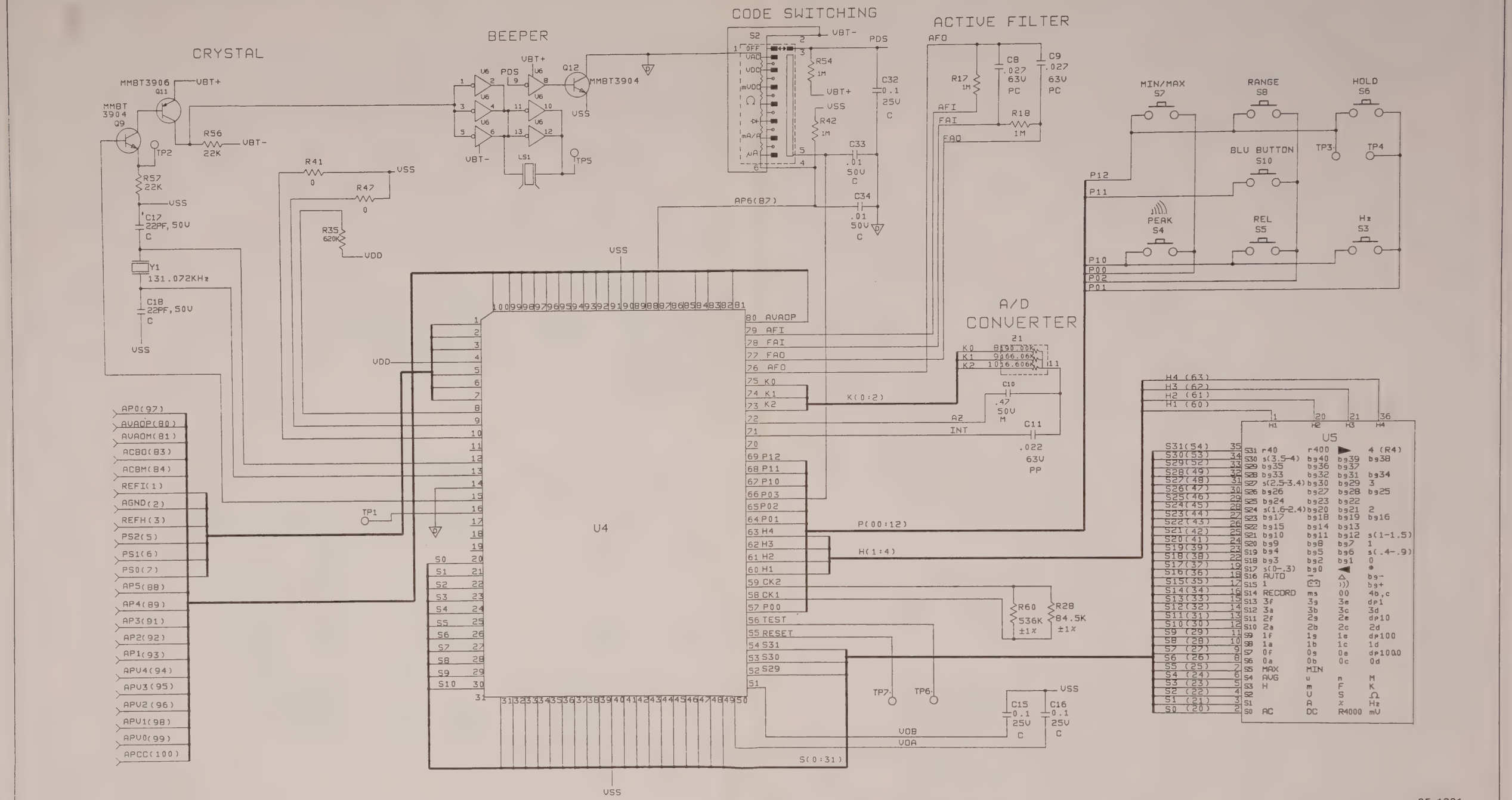
ROTARY SWITCH INFORMATION

POSITION	FRONT	REAR	TEST ROTARY SWITCH** ±12 COUNTS
OFF		1-2*	
ACV		1-2	0
DCV	3-4	1-2	32
mVDC	3-4 11-12		64
Ω	3-4-5 11-12		96
⊣▷	4-6 11-12	1-2	128
mA/A		9-8 1-2*	160
μA	3-4*	10-9	192

* CONNECTION NOT USED FOR OPERATION
** POWER UP OPTION
PRESS RANGE BUTTON DOWN FOR 2 SECS WHILE TURNING ON METER

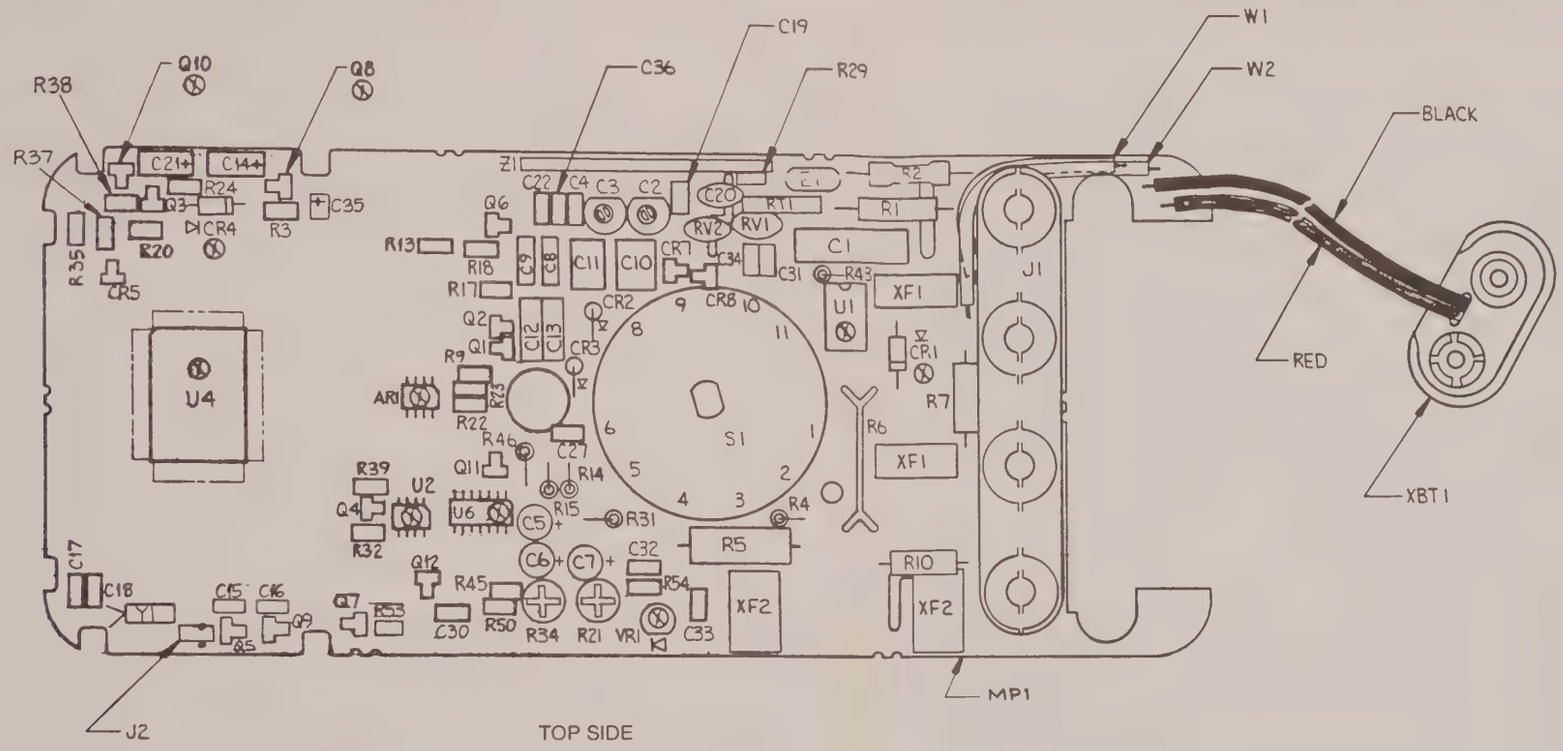
85-1201
(1 of 2)

Figure 5-2. Fluke 85 A1 Main PCA (cont)



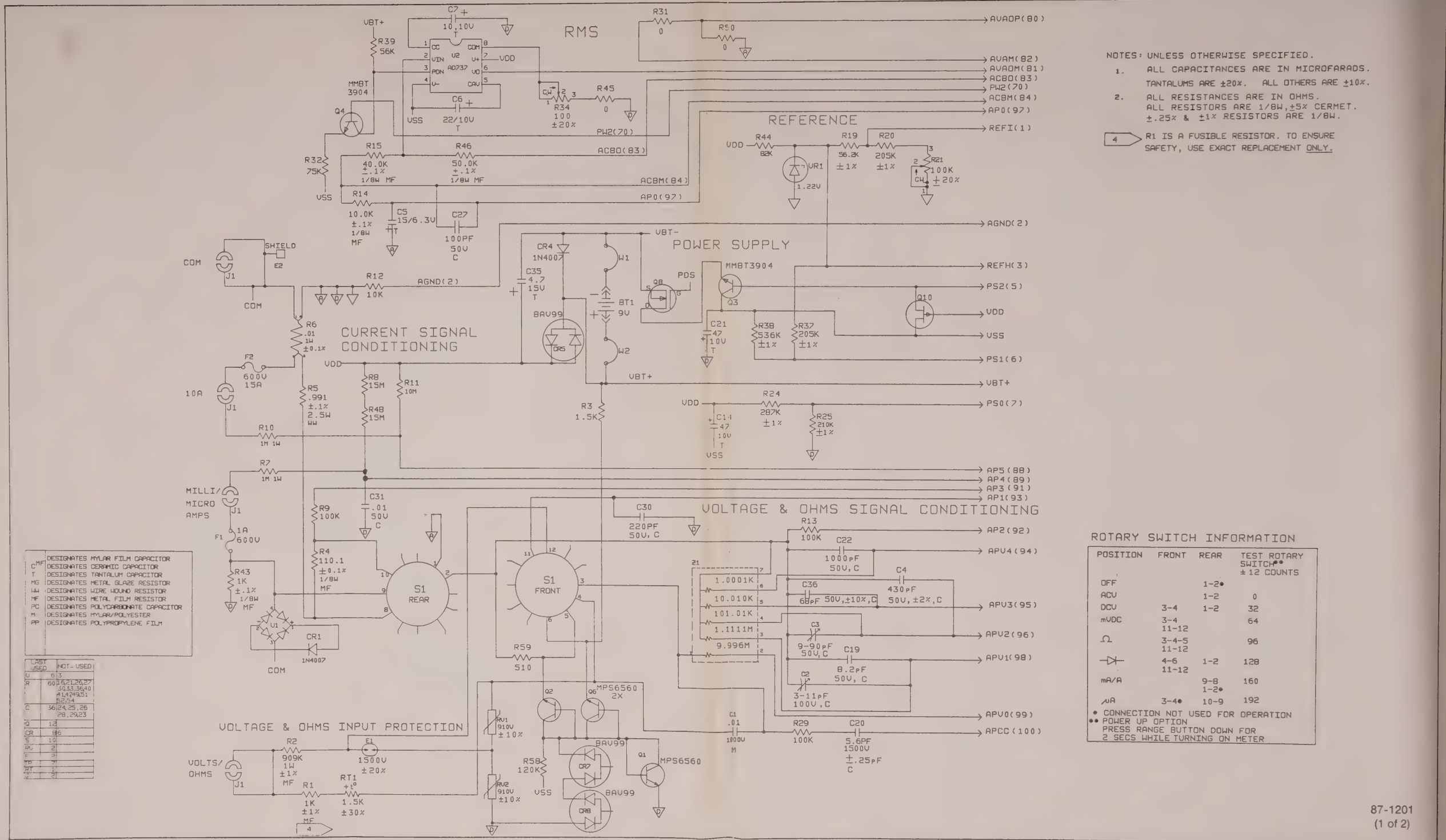
85-1201
(2 of 2)

Figure 5-2. Fluke 85 A1 Main PCA (cont)



87-4001

Figure 5-3. Fluke 87 A1 Main PCA



NOTES: UNLESS OTHERWISE SPECIFIED.

1. ALL CAPACITANCES ARE IN MICROFARADS. TANTALUMS ARE ±20%. ALL OTHERS ARE ±10%.
2. ALL RESISTANCES ARE IN OHMS. ALL RESISTORS ARE 1/8W, ±5% CERMET. ±.25% & ±1% RESISTORS ARE 1/8W.

4 R1 IS A FUSIBLE RESISTOR. TO ENSURE SAFETY, USE EXACT REPLACEMENT ONLY.

	DESIGNATES
CMF	MYLAR FILM CAPACITOR
C	CERAMIC CAPACITOR
T	TANTALUM CAPACITOR
MG	METAL GLAZE RESISTOR
WW	WIRE WOUND RESISTOR
MF	METAL FILM RESISTOR
PC	POLYCARBONATE CAPACITOR
M	MYLAR/POLYESTER
PP	POLYPROPYLENE FILM

	LAST USED	NOT-USED
U	6	3
R	60	16,21,26,27 30,33,36,40 #1,4,7,49,51 52,54
C	36	24,25,26 28,29,23
Q	12	
CR	8	6
S	10	
RV	2	
F	3	
TP	4	
XT	1	
K	3	

ROTARY SWITCH INFORMATION

POSITION	FRONT	REAR	TEST ROTARY SWITCH** ±12 COUNTS
OFF		1-2*	
ACV		1-2	0
DCV	3-4	1-2	32
mVDC	3-4 11-12		64
Ω	3-4-5 11-12		96
⊣▷	4-6 11-12	1-2	128
mA/A		9-8 1-2*	160
μA	3-4*	10-9	192

* CONNECTION NOT USED FOR OPERATION
** POWER UP OPTION PRESS RANGE BUTTON DOWN FOR 2 SECS WHILE TURNING ON METER

87-1201
(1 of 2)

Figure 5-3. Fluke 87 A1 Main PCA (cont)

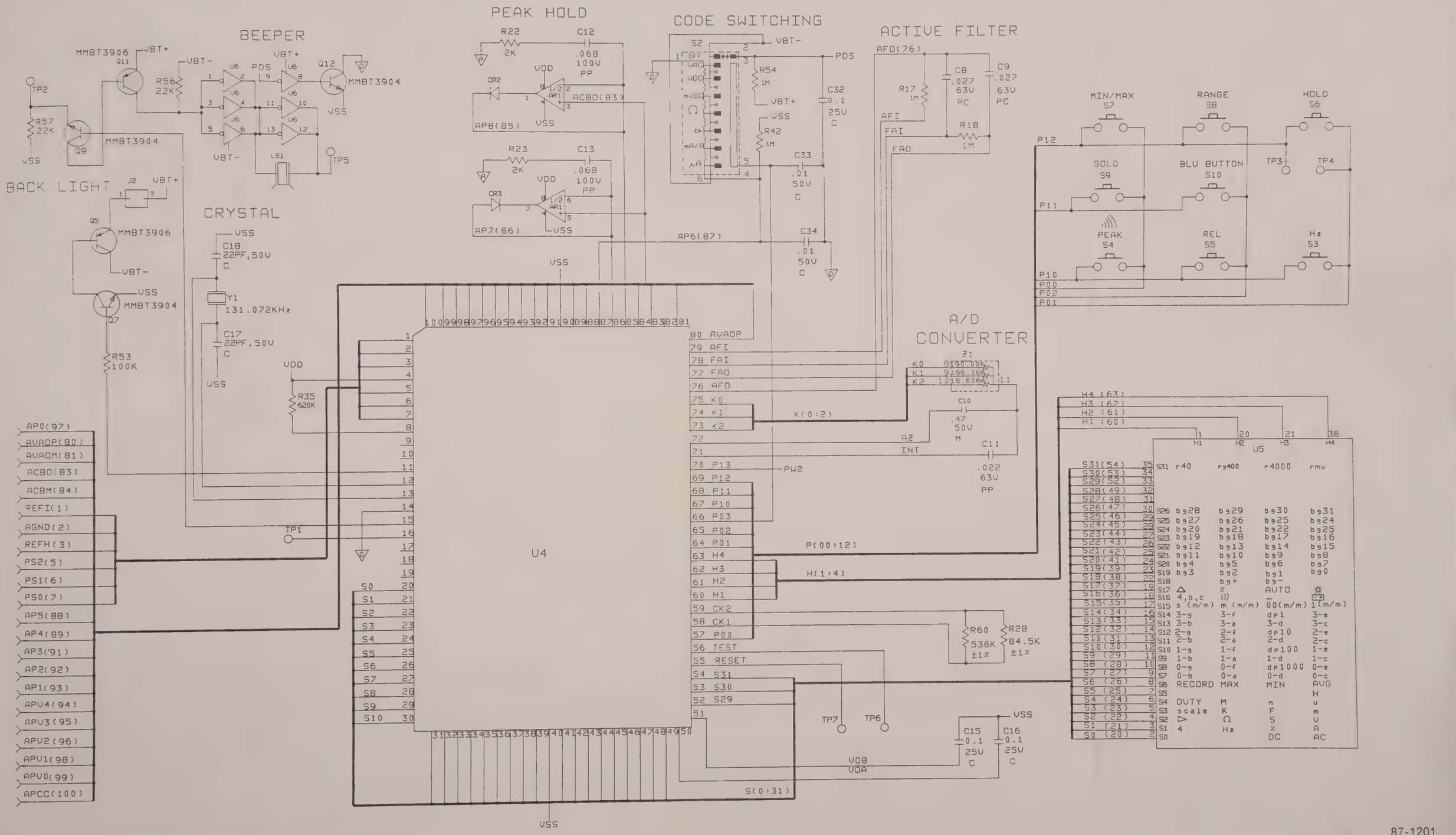


Figure 5-3. Fluke 87 A1 Main PCA (cont)

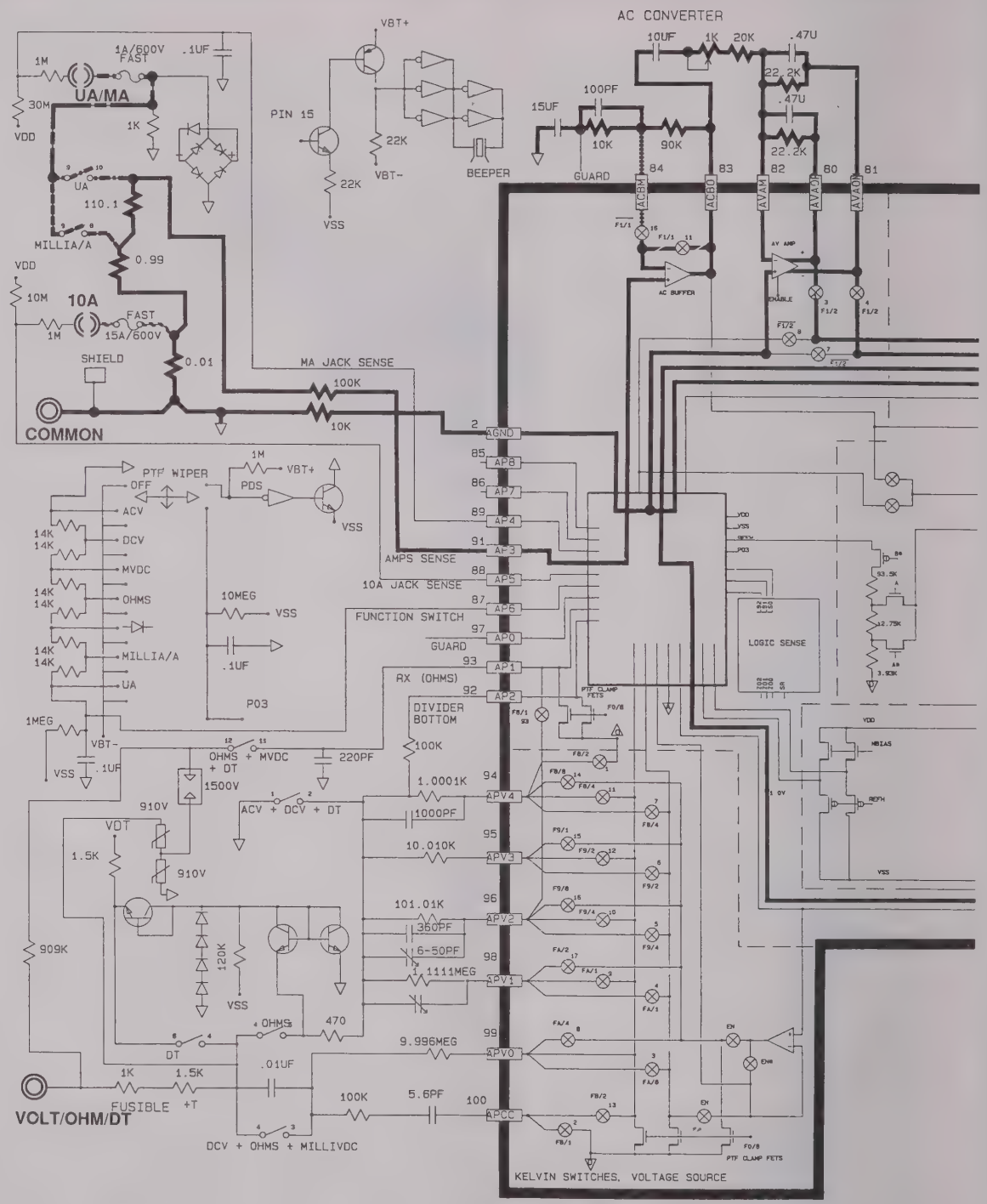
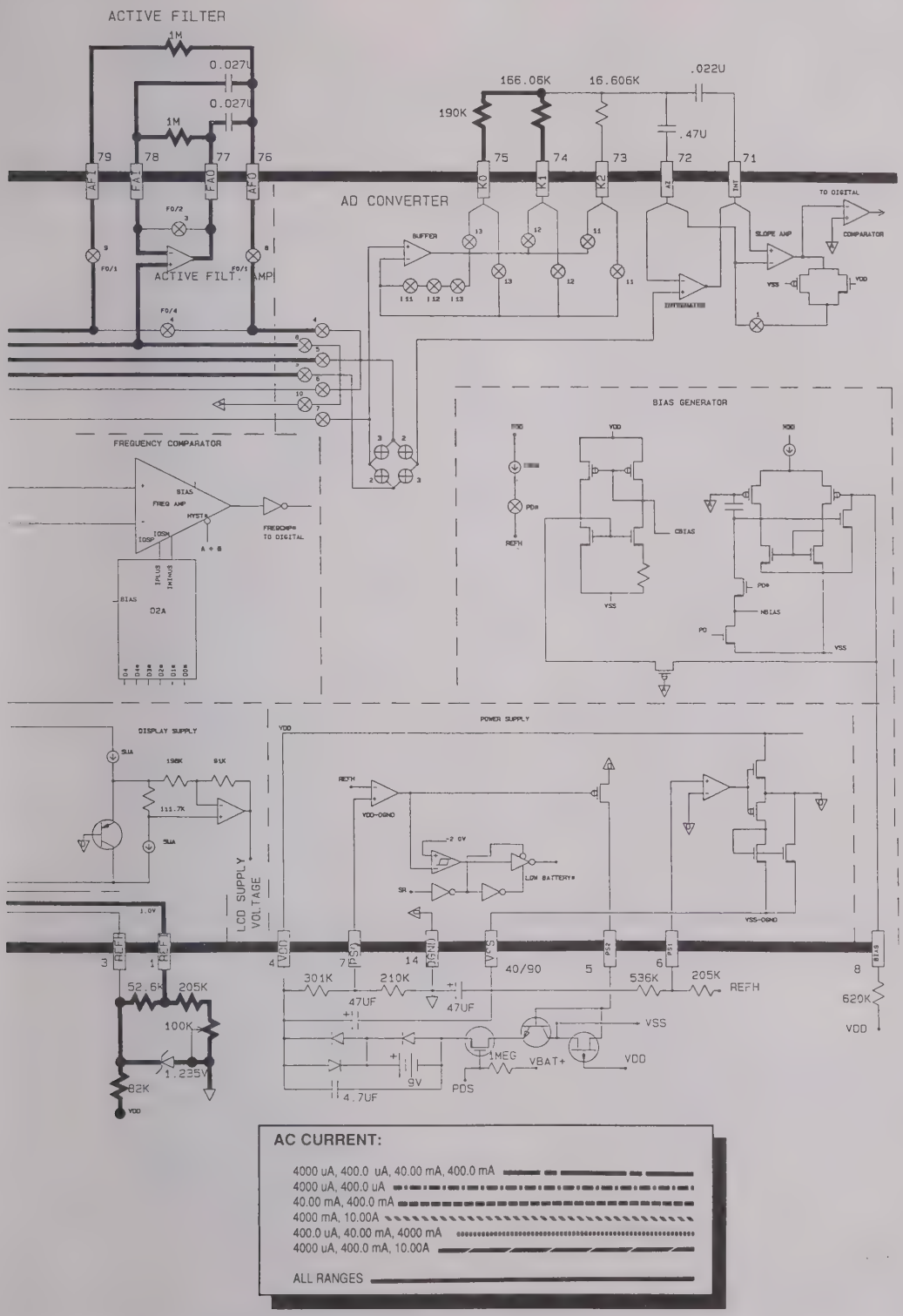


Figure 5-4. AC Current Signal Flow


ACTIVE FILTER
1M
0.027U
0.027U
1M
79
78
77
76
AD CONVERTER
166.06K
16.606K
.022U
190K
.47U
75
74
73
72
71
TO DIGITAL
COMPARATOR
SLOPE AMP
BUFFER
ACTIVE FILT. AMP
FREQUENCY COMPARATOR
BIAS GENERATOR
POWER SUPPLY
DISPLAY SUPPLY
LCD SUPPLY VOLTAGE
301K
210K
47UF
47UF
536K
205K
REFH
620K
VDD
VSS
1MEG
VBAT+
9V
4.7UF
PDS
52.6K
205K
100K
1.235V
82K
40/90
AC CURRENT:
4000 uA, 400.0 uA, 40.00 mA, 400.0 mA
4000 uA, 400.0 uA
40.00 mA, 400.0 mA
4000 mA, 10.00A
400.0 uA, 40.00 mA, 4000 mA
4000 uA, 400.0 mA, 10.00A
ALL RANGES

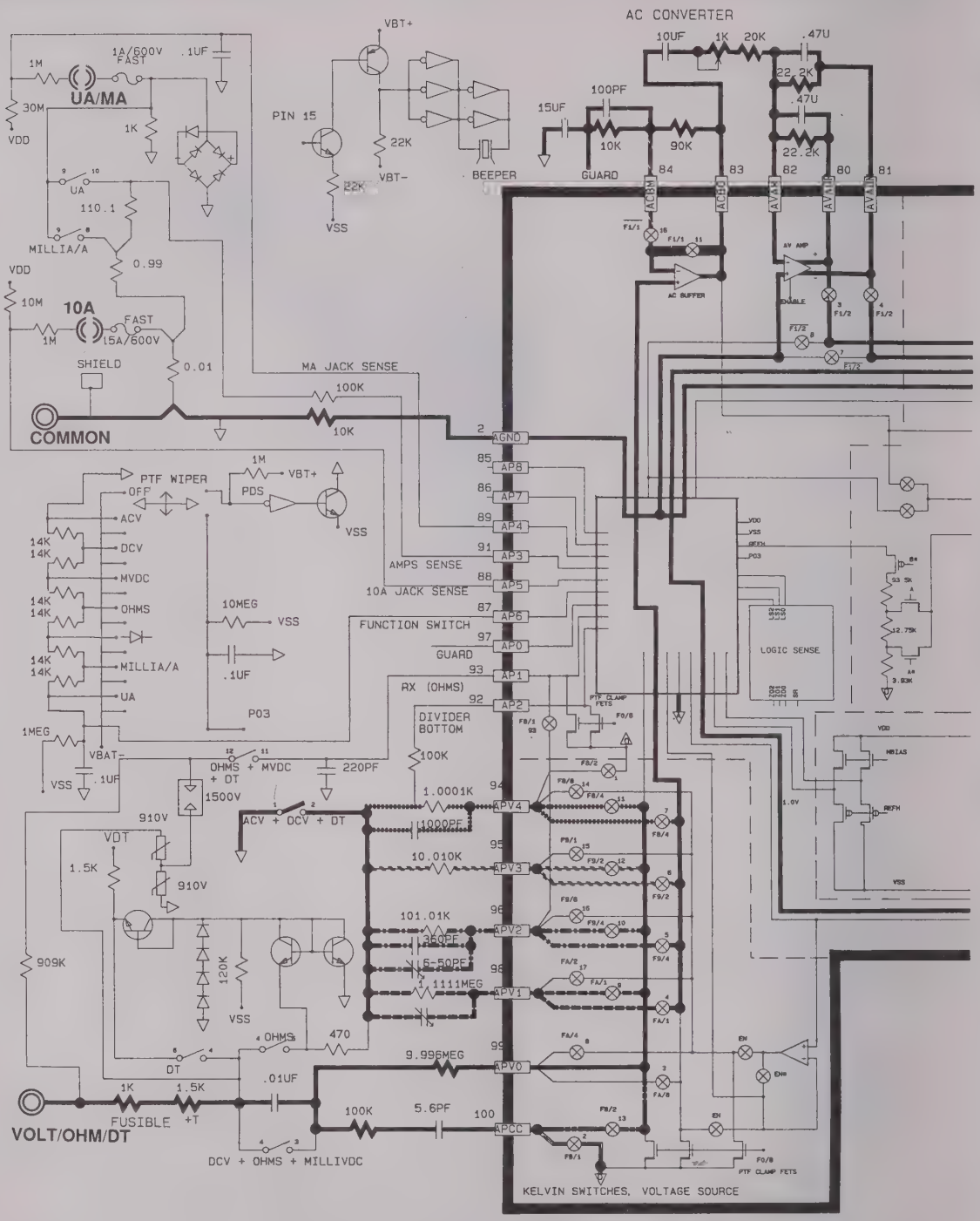
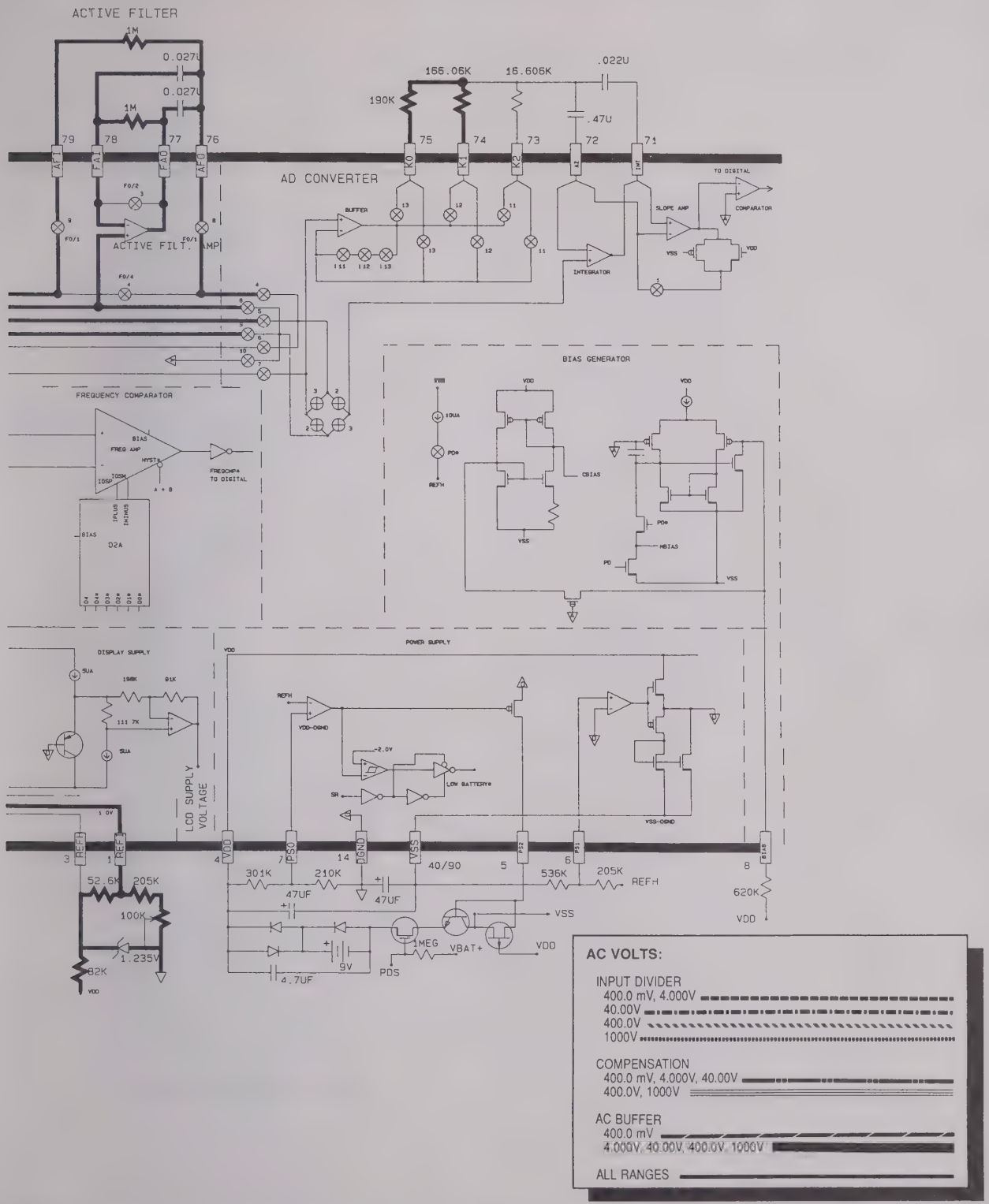


Figure 5-5. AC Volts Signal Flow (Models 83, 85)


ACTIVE FILTER
AD CONVERTER
ACTIVE FILT. AMP
FREQUENCY COMPARATOR
BIAS GENERATOR
POWER SUPPLY
DISPLAY SUPPLY
LCD SUPPLY VOLTAGE
AC VOLTS:
INPUT DIVIDER
400.0 mV, 4.000V
40.00V
400.0V
1000V
COMPENSATION
400.0 mV, 4.000V, 40.00V
400.0V, 1000V
AC BUFFER
400.0 mV
4.000V, 40.00V, 400.0V, 1000V
ALL RANGES

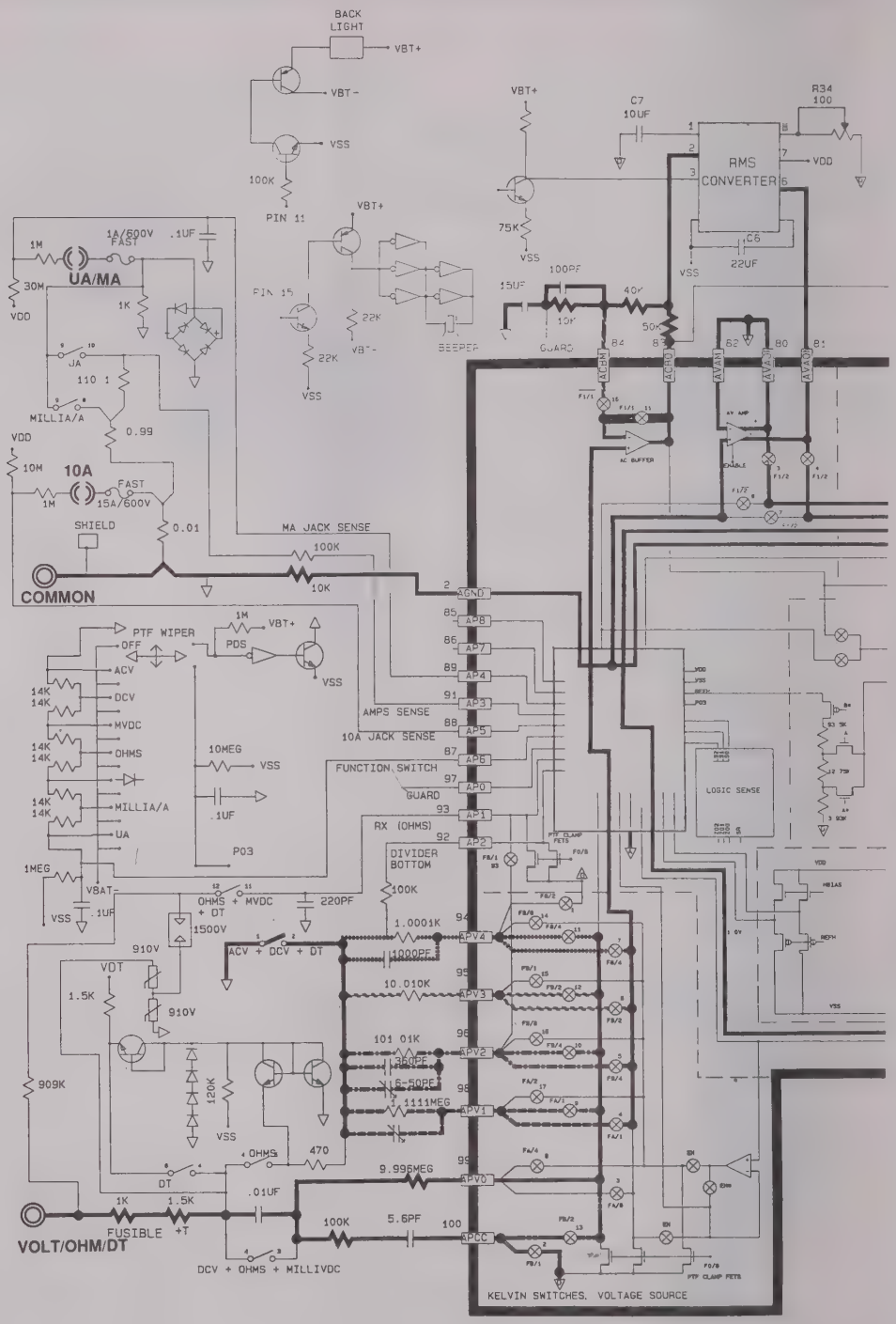
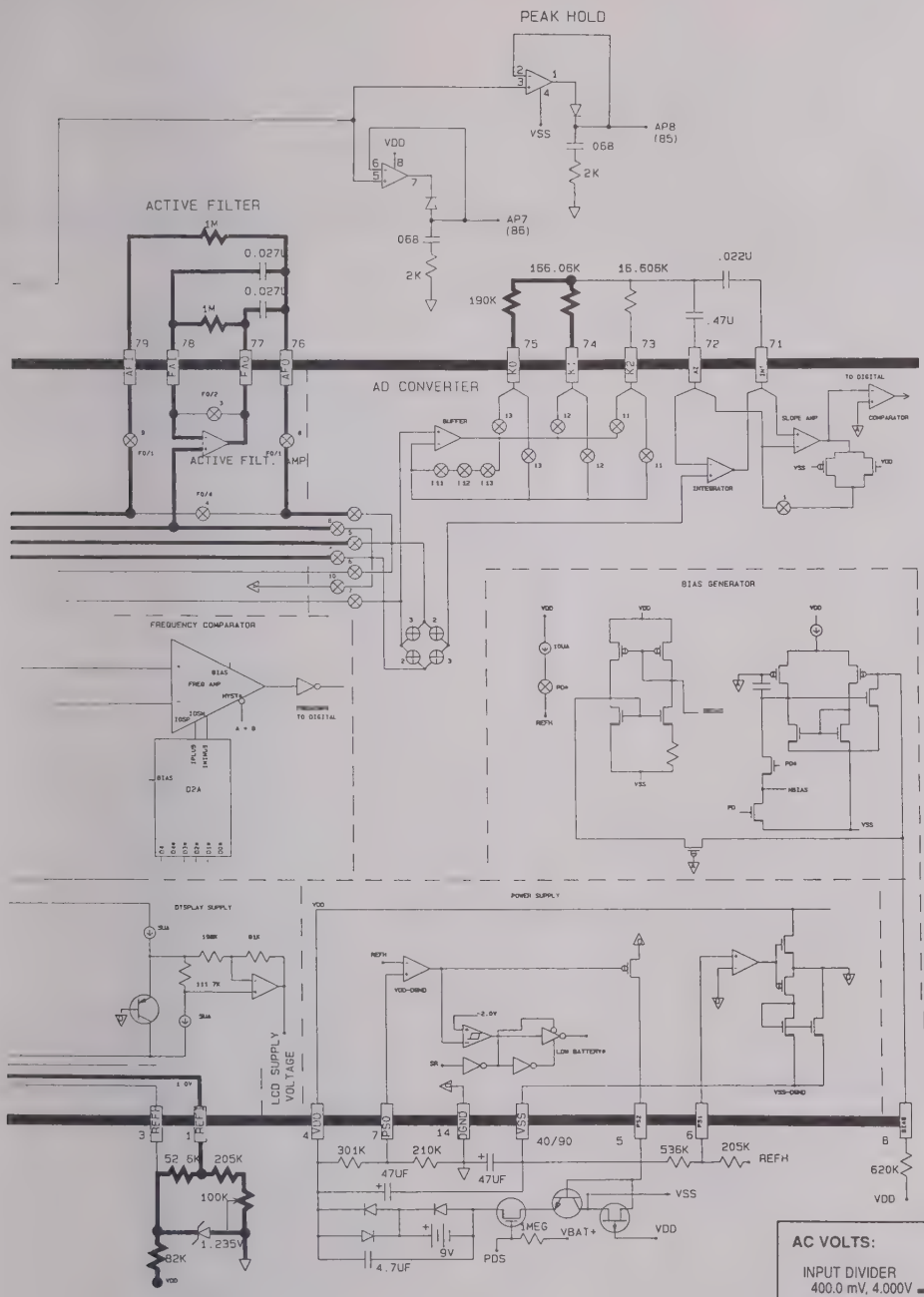


Figure 5-6. AC Volts Signal Flow (Model 87)



AC VOLTS:

INPUT DIVIDER
- 400.0 mV, 4.000V
- 40.00V
- 400.0V
- 1000V

COMPENSATION
- 400.0 mV, 4.000V, 40.00V
- 400.0V, 1000V

AC BUFFER
- 400.0 mV
- 4.000V, 40.00V, 400.0V, 1000V

ALL RANGES

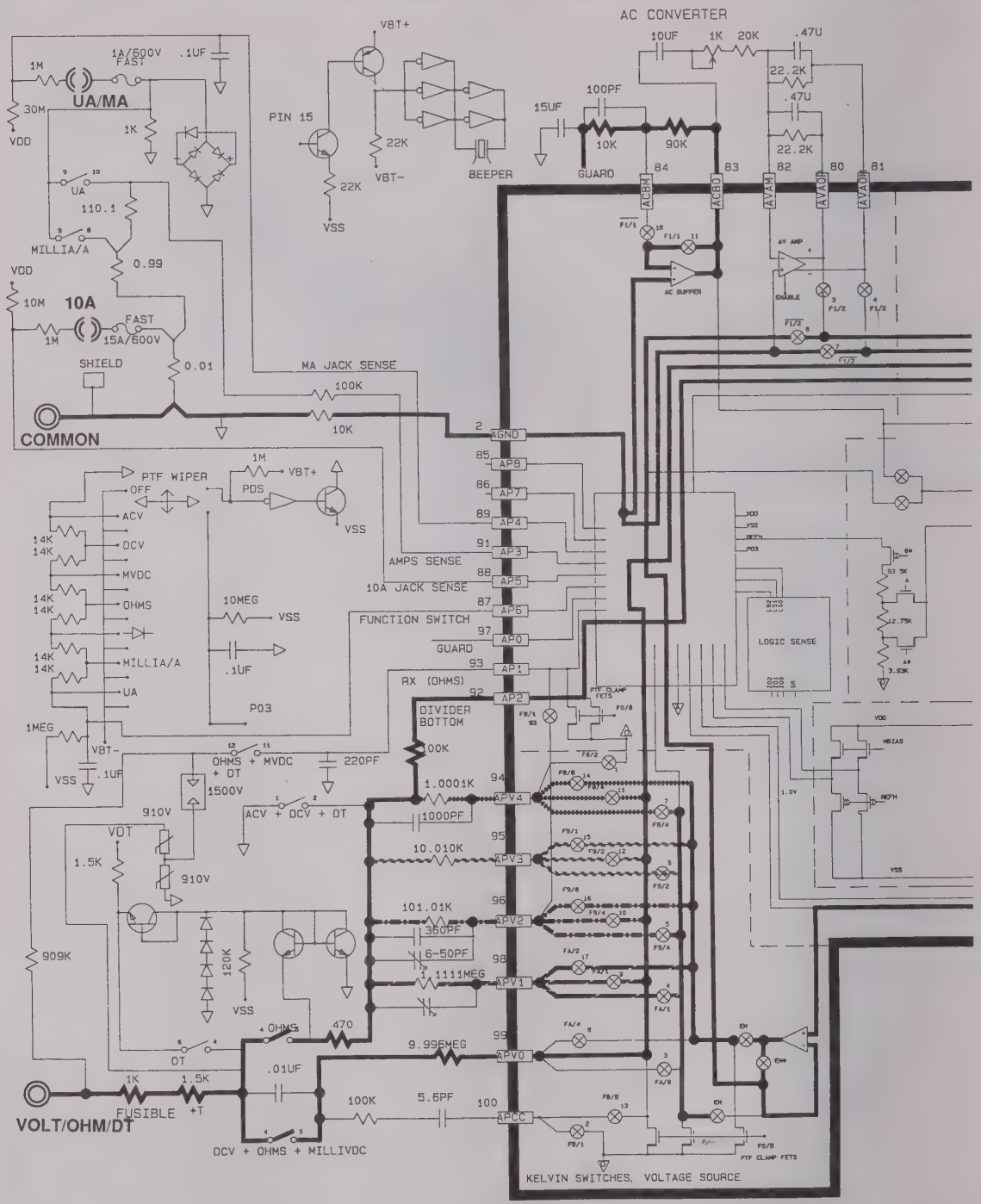
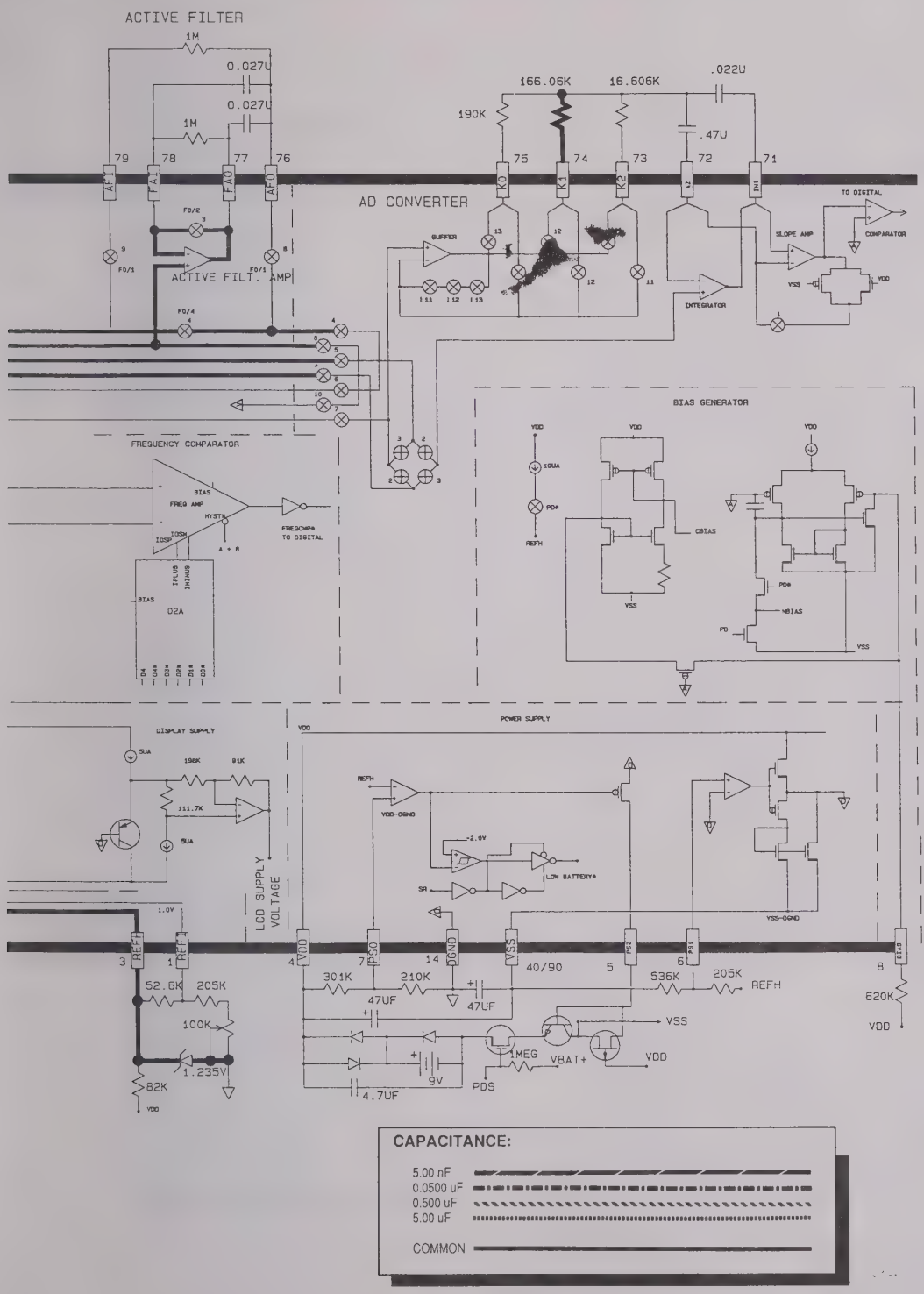


Figure 5-7. Capacitance Signal Flow



CAPACITANCE:

5.00 nF
0.0500 uF
0.500 uF
5.00 uF

COMMON

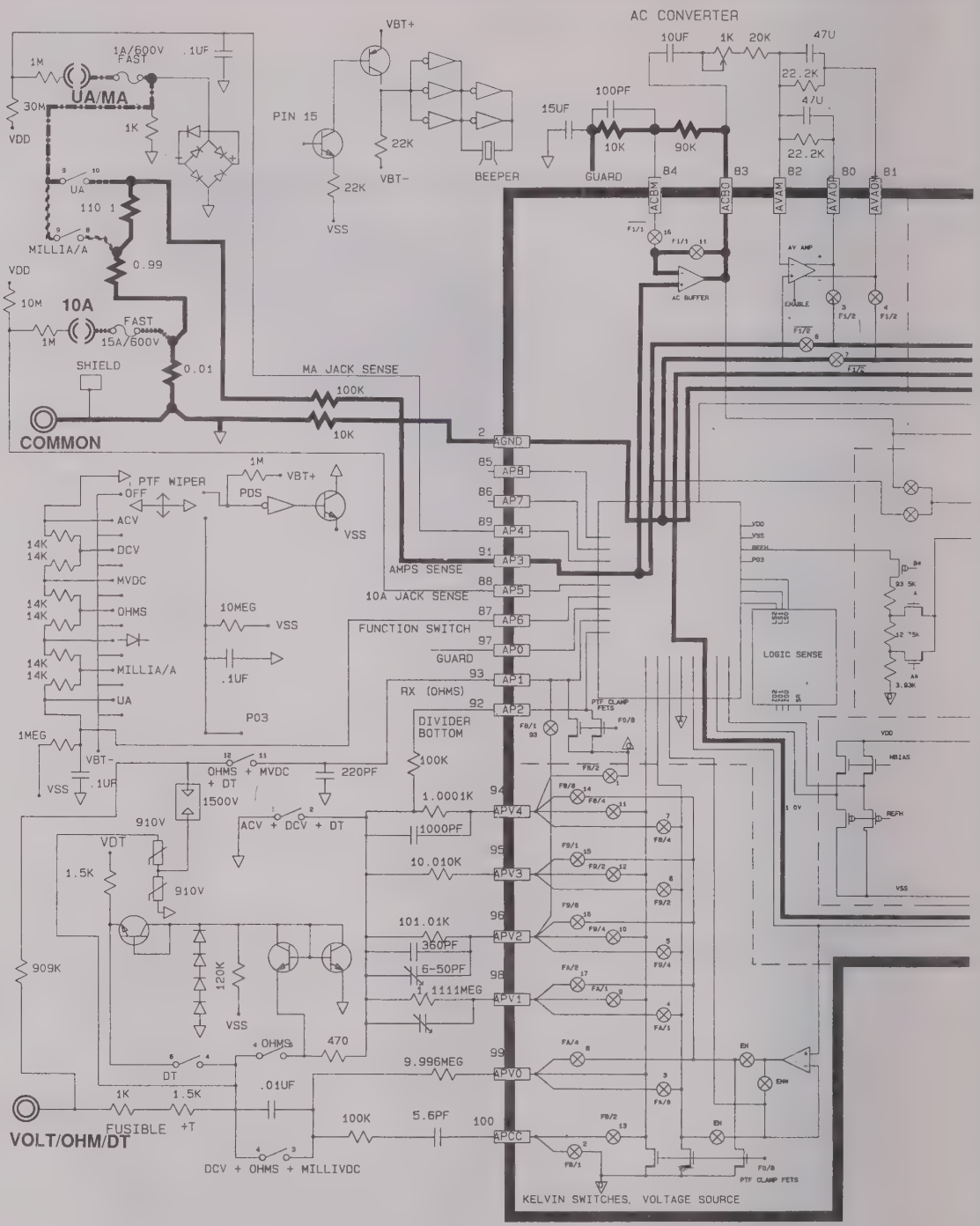
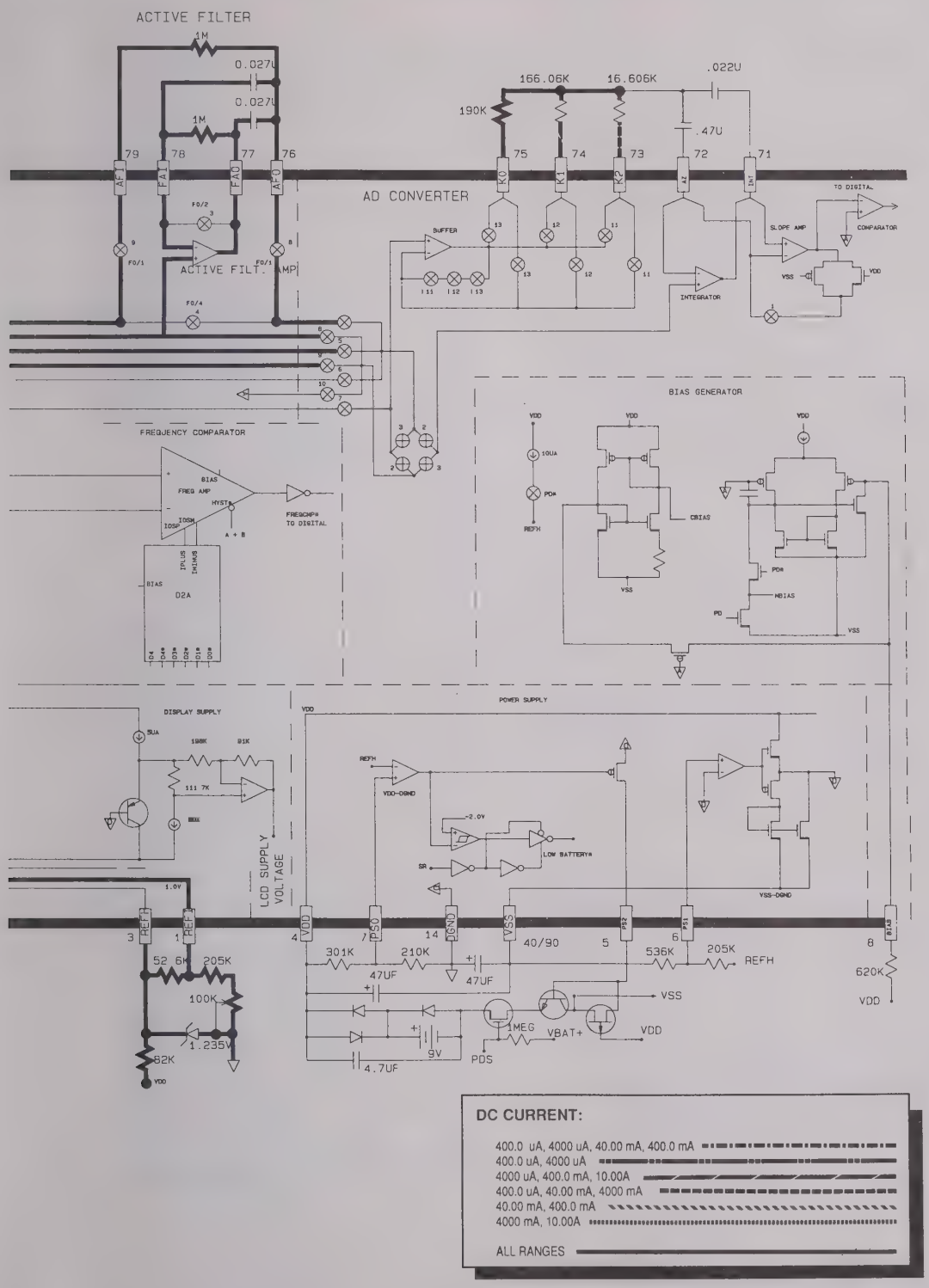


Figure 5-8. DC Current Signal Flow


ACTIVE FILTER
AD CONVERTER
BUFFER
INTEGRATOR
SLOPE AMP
COMPARATOR
ACTIVE FILT. AMP
FREQUENCY COMPARATOR
BIAS GENERATOR
POWER SUPPLY
DISPLAY SUPPLY
LCD SUPPLY VOLTAGE
LOW BATTERY#
VDD-DGND
VSS-DGND
REFH
VSS
VDD
VBAT+
PDS
DC CURRENT:
400.0 uA, 4000 uA, 40.00 mA, 400.0 mA
400.0 uA, 4000 uA
4000 uA, 400.0 mA, 10.00A
400.0 uA, 40.00 mA, 4000 mA
40.00 mA, 400.0 mA
4000 mA, 10.00A
ALL RANGES

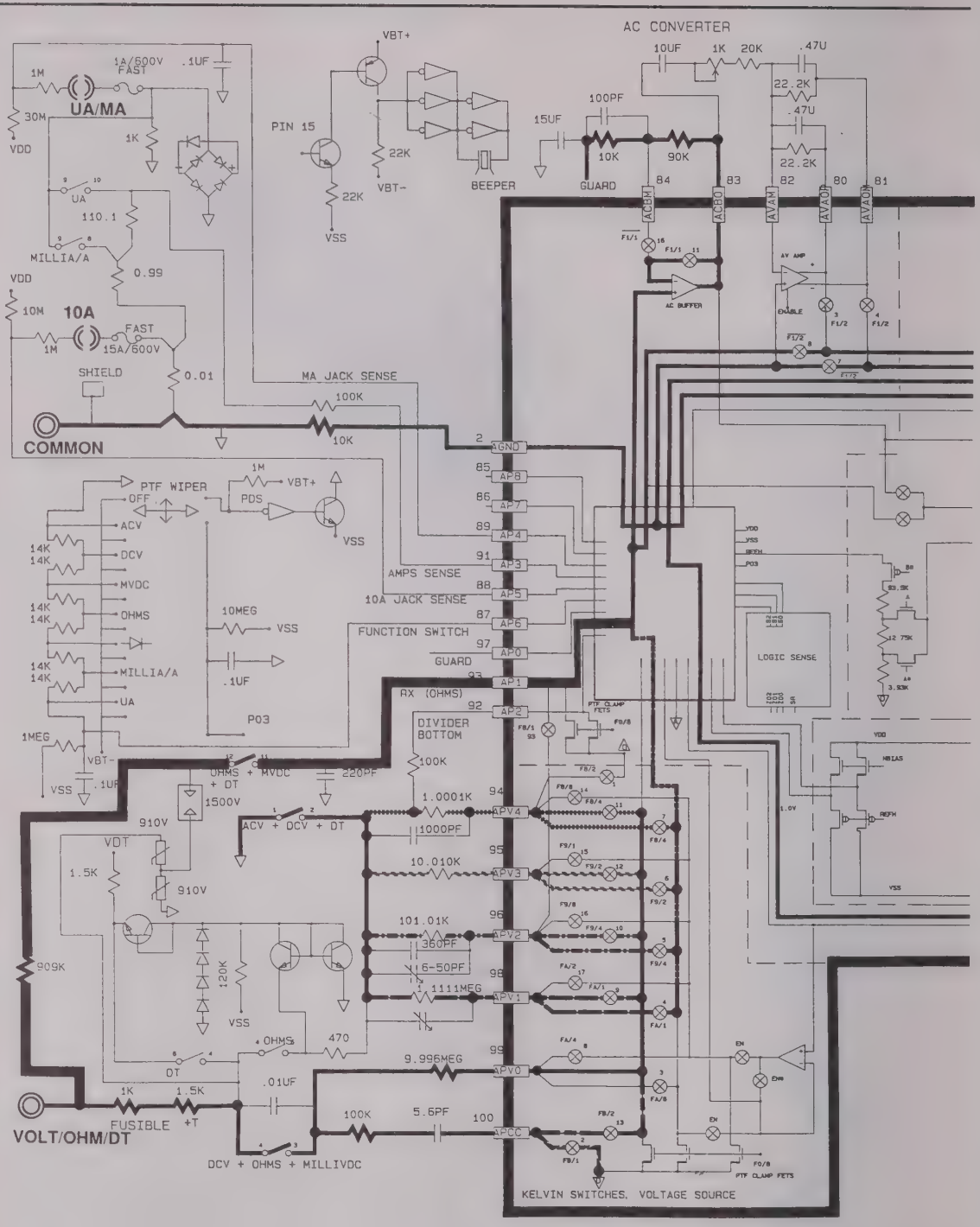
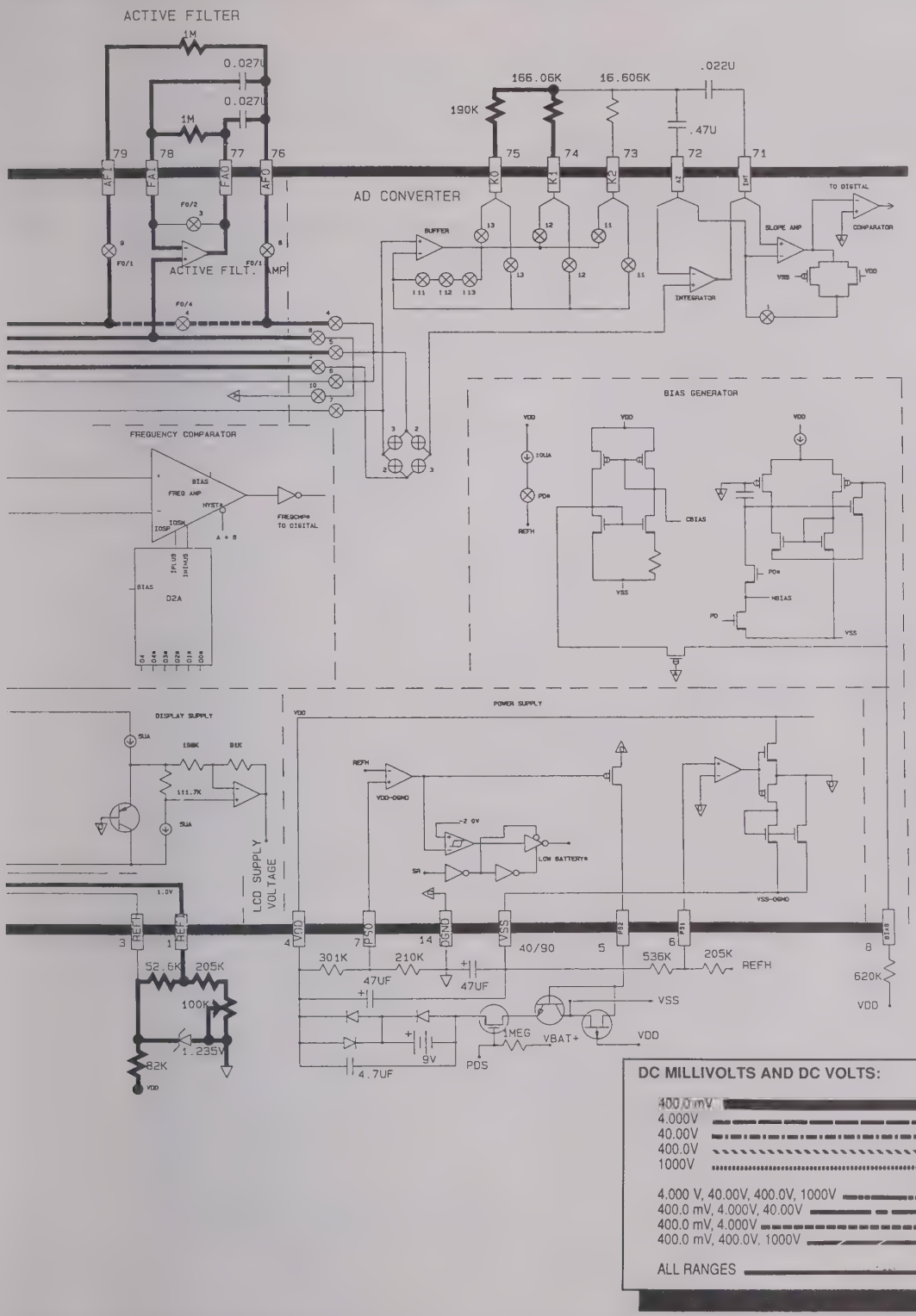


Figure 5-9. DC Millivolts and DC Volts Signal Flow



DC MILLIVOLTS AND DC VOLTS:

400.0 mV
4.000V
40.00V
400.0V
1000V

4.000 V, 40.00V, 400.0V, 1000V
400.0 mV, 4.000V, 40.00V
400.0 mV, 4.000V
400.0 mV, 400.0V, 1000V

ALL RANGES

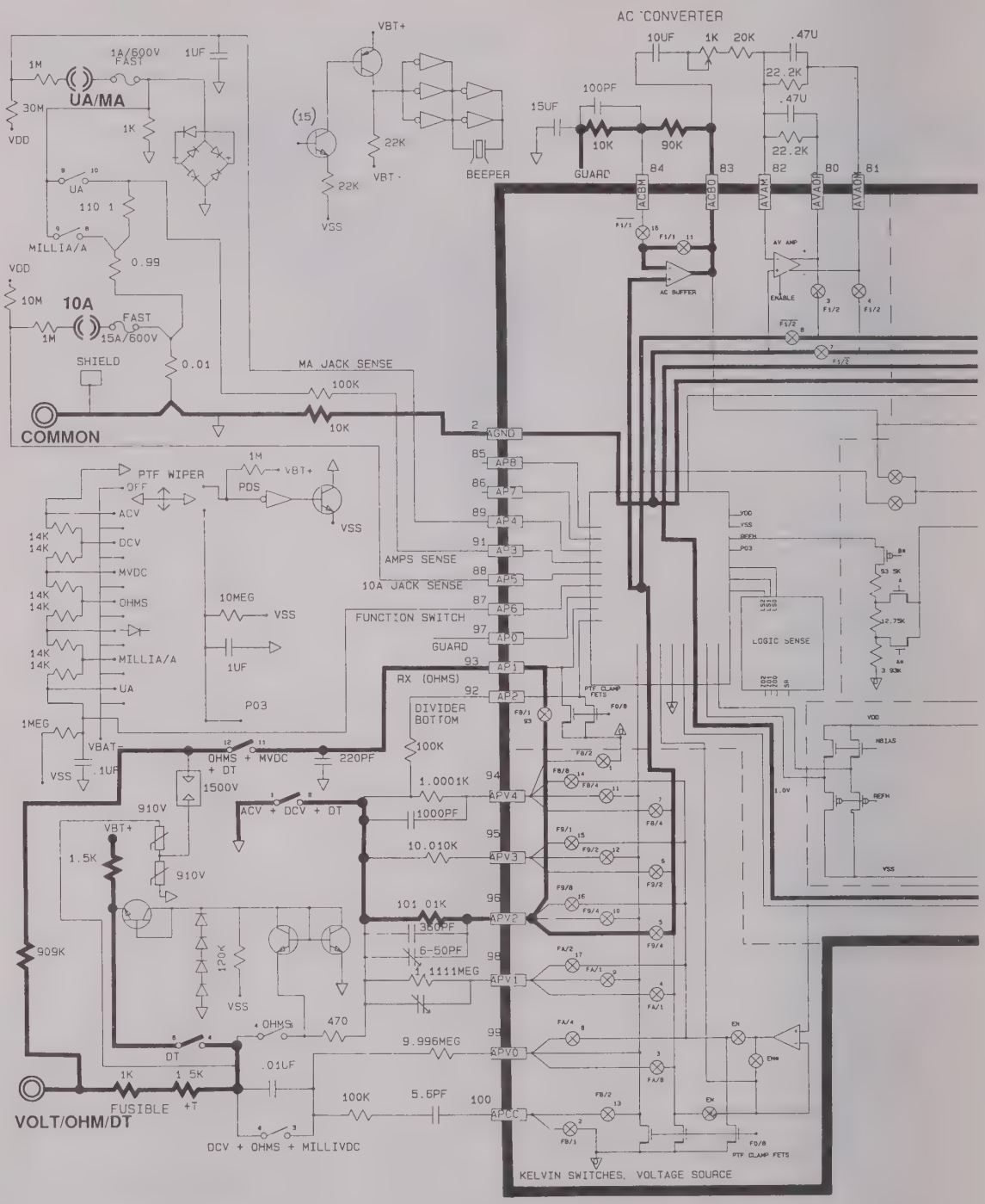
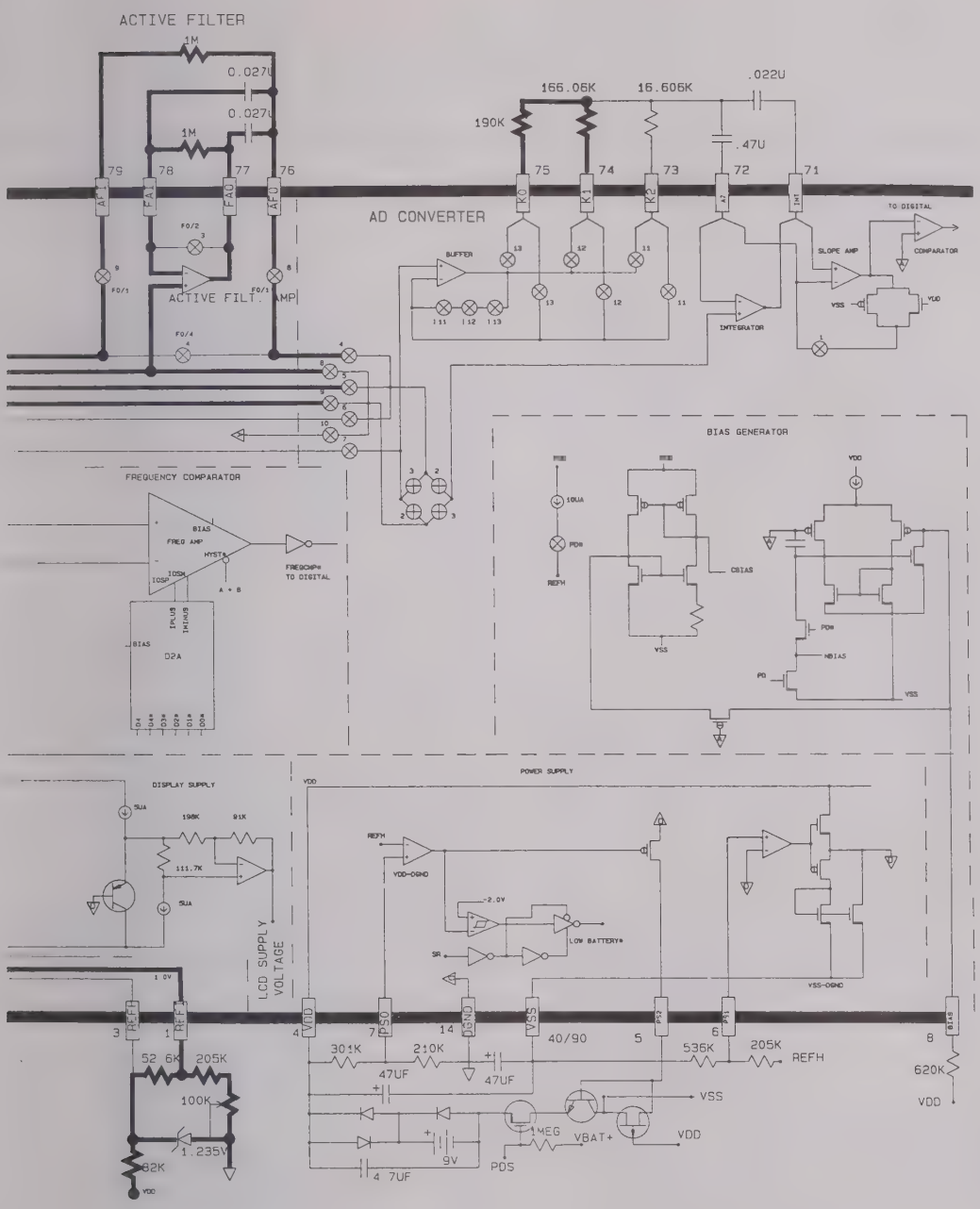


Figure 5-10. Diode Test Signal Flow


ACTIVE FILTER
2M
0.027U
0.027U
1M
79
78
77
76
AF1
F1
F4U
4FU
AD CONVERTER
166.06K
16.606K
.022U
190K
.47U
75
74
73
72
71
K0
K1
K2
2
INT
TO DIGITAL
COMPARATOR
SLOPE AMP
BUFFER
INTEGRATOR
VSS
VDD
FO/2
FO/1
FO/4
ACTIVE FILT. AMP
FREQUENCY COMPARATOR
BIAS
FREQ AMP
HYST
IOSH
IOSP
A + B
FREQCMP*
TO DIGITAL
IPLUS
IMINUS
D2A
BIAS GENERATOR
10UA
PDB
REFH
CBIAS
NBIAS
PD
POWER SUPPLY
DISPLAY SUPPLY
5UA
198K
91K
111.7K
LCD SUPPLY VOLTAGE
1.0V
REFH
REFL
52.6K
205K
100K
1.235V
82K
VDD-OGND
-2.0V
LOW BATTERY*
SR
VSS-OGND
VDD
PSO
OGND
VSS
40/90
PAS
BIAS
301K
210K
47UF
47UF
536K
205K
REFH
620K
VSS
MEG
VBAT+
VDD
9V
4.7UF
PDS

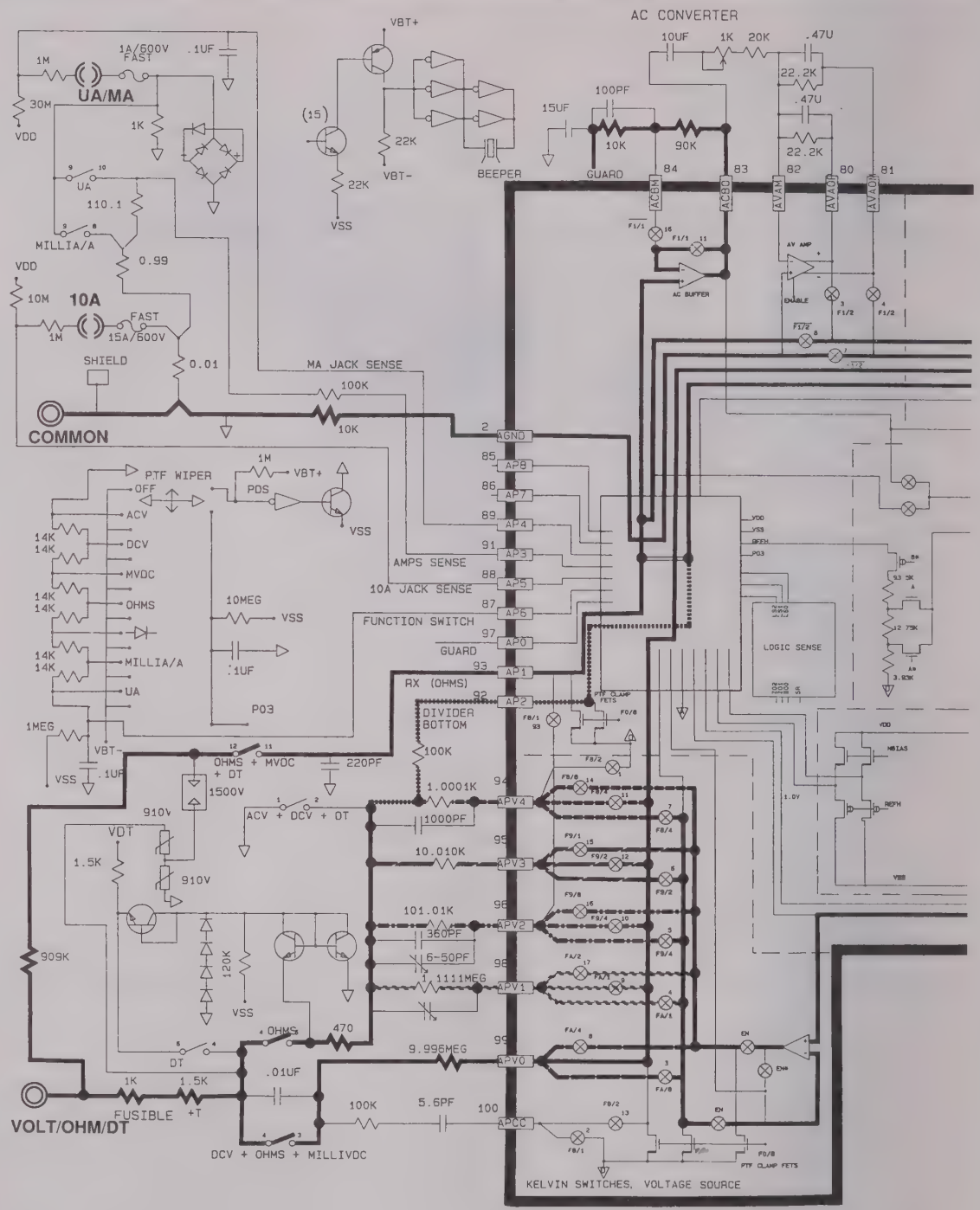
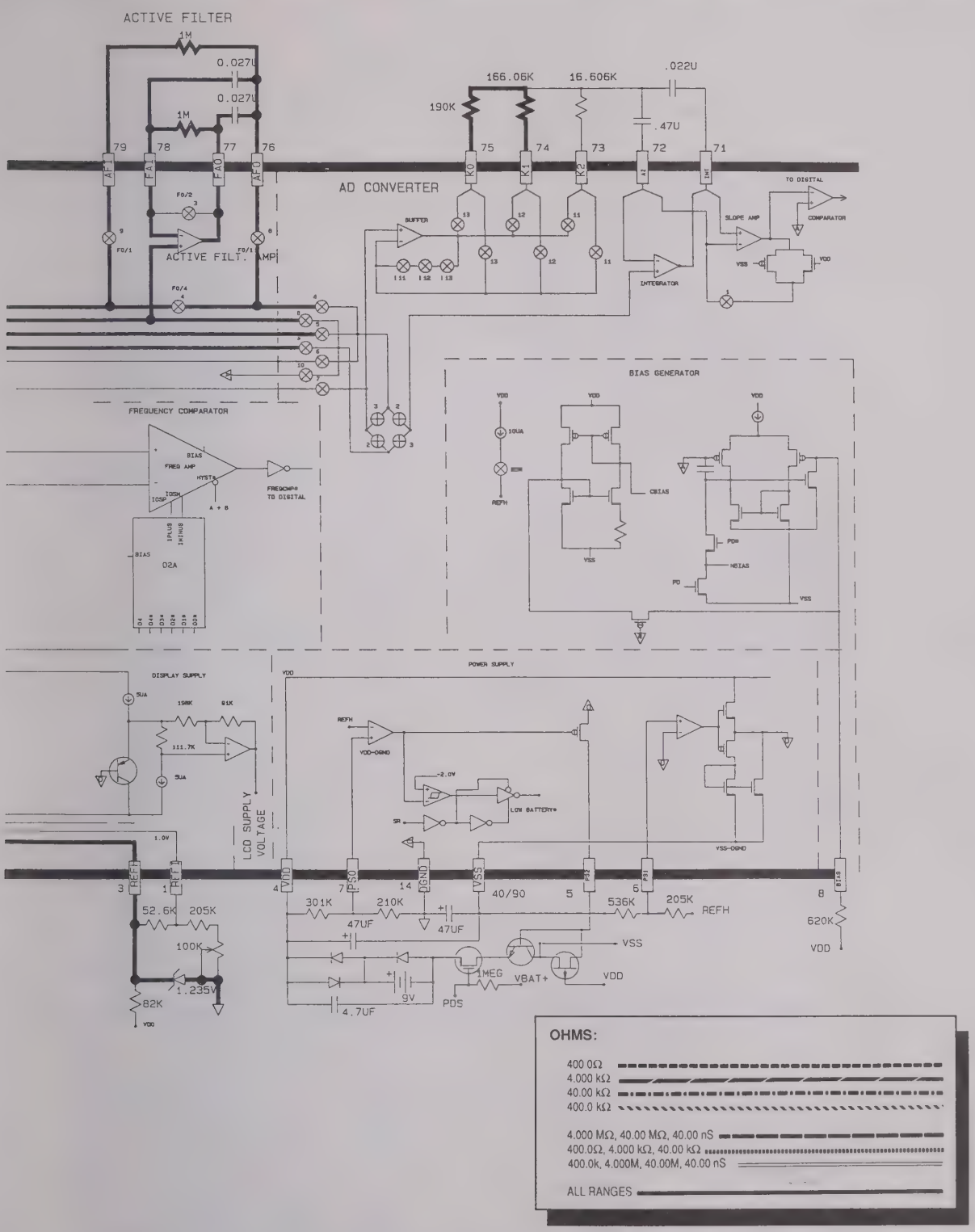


Figure 5-11. Ohms Signal Flow



OHMS:

400.0Ω
4.000 kΩ
40.00 kΩ
400.0 kΩ

4.000 MΩ, 40.00 MΩ, 40.00 nS
400.0Ω, 4.000 kΩ, 40.00 kΩ
400.0k, 4.000M, 40.00M, 40.00 nS

ALL RANGES

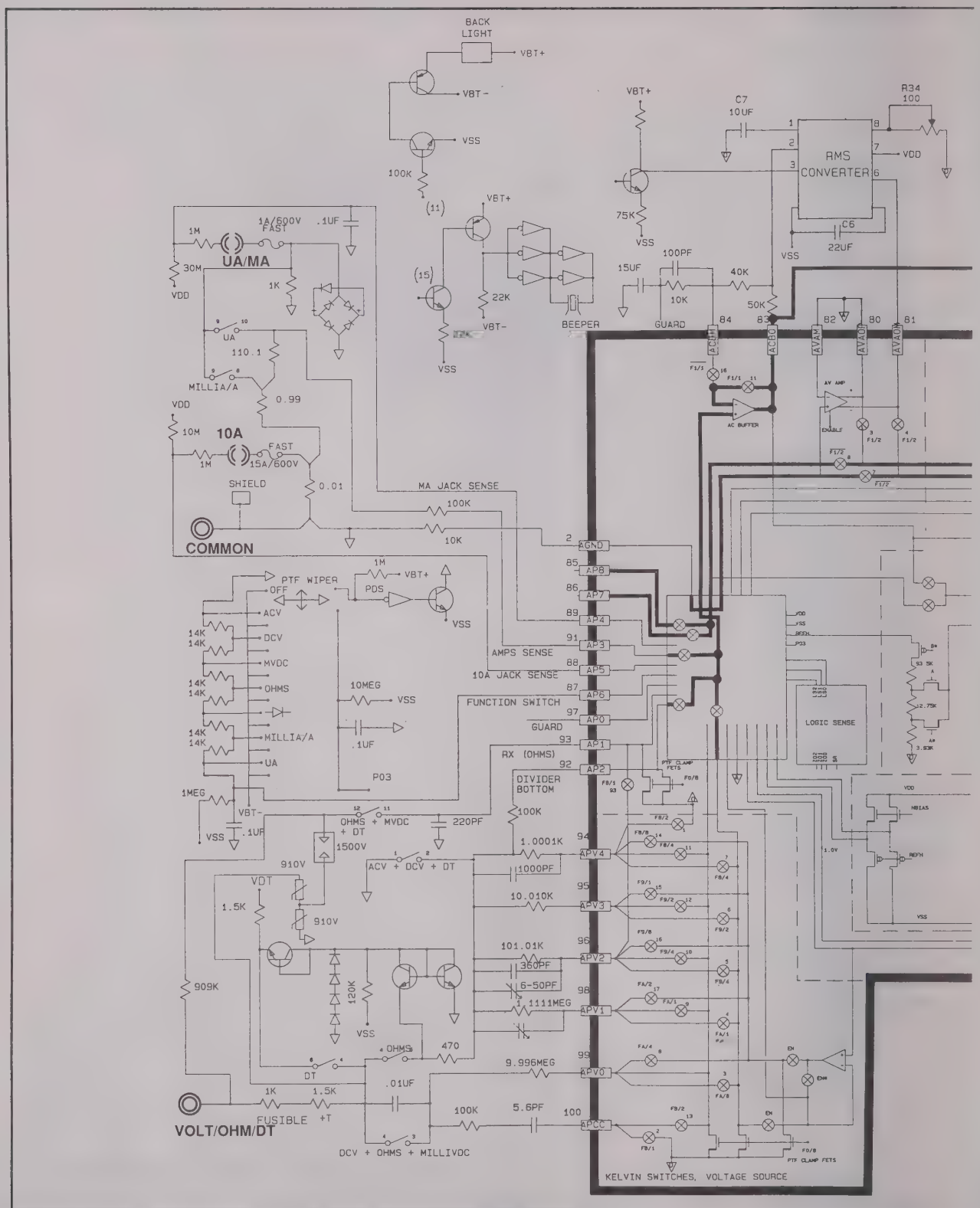
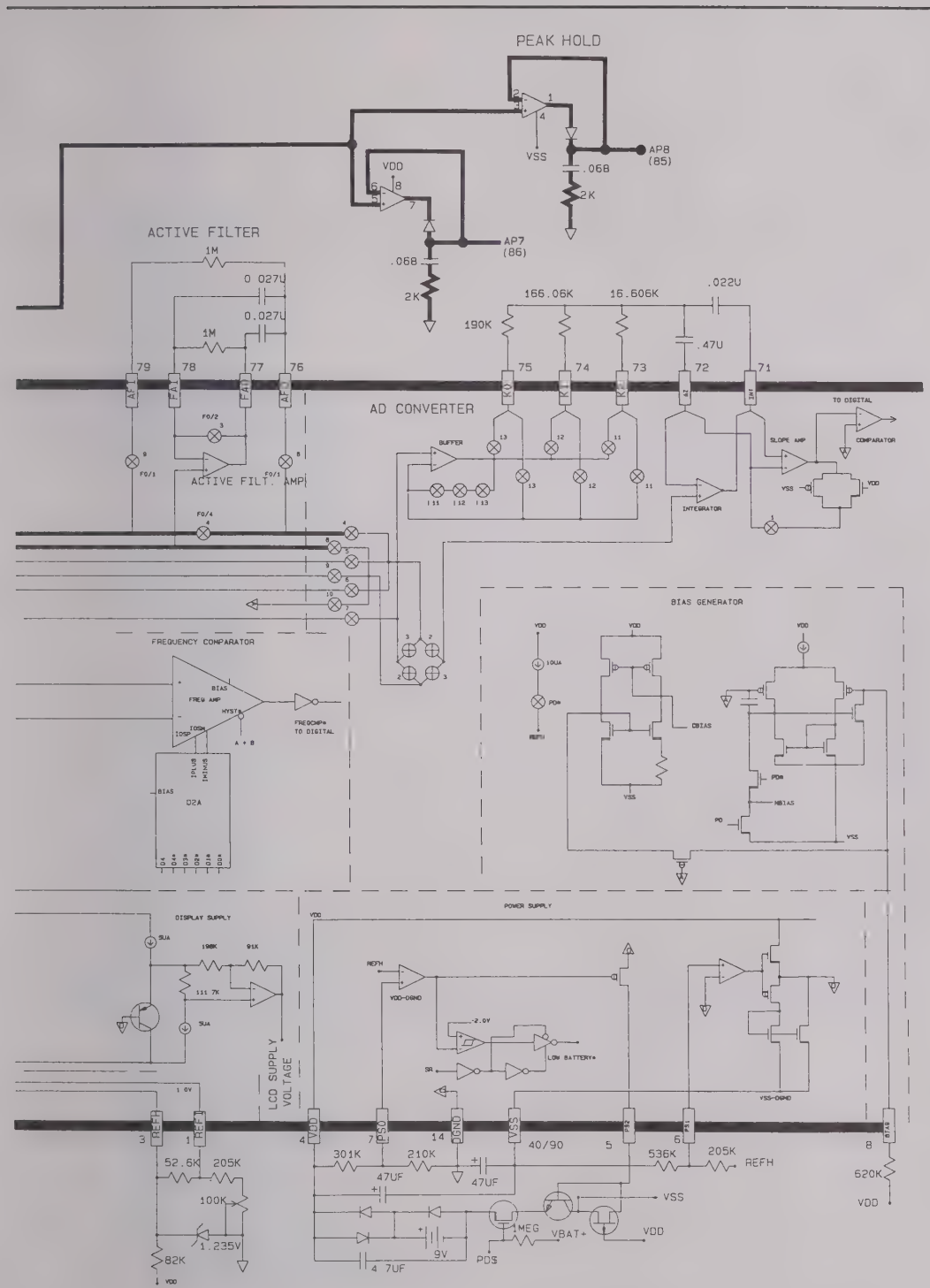


Figure 5-12. Peak/Hold Signal Flow (Model 87)


PEAK HOLD
VSS
AP8
(85)
.068
2K
VDD
AP7
(86)
.068
2K
ACTIVE FILTER
1M
0.027U
0.027U
1M
166.06K
16.606K
.022U
190K
.47U
79
78
77
76
75
74
73
72
71
AD CONVERTER
TO DIGITAL
BUFFER
SLOPE AMP
COMPARATOR
INTEGRATOR
VSS
VDD
ACTIVE FILT. AMP
FREQUENCY COMPARATOR
BIAS GENERATOR
10UA
DBIAS
PDB
NBIAS
PD
VSS
BIAS
FREQ AMP
HYSTR
FREQCMP=
TO DIGITAL
A + B
D2A
DISPLAY SUPPLY
POWER SUPPLY
LCD SUPPLY
VOLTAGE
VDD-DGND
-2.0V
LOW BATTERY=
VSS-DGND
52.6K
205K
100K
1.235V
82K
301K
210K
47UF
47UF
40/90
536K
205K
REFH
620K
1MEG
VBAT+
9V
4.7UF
PD$

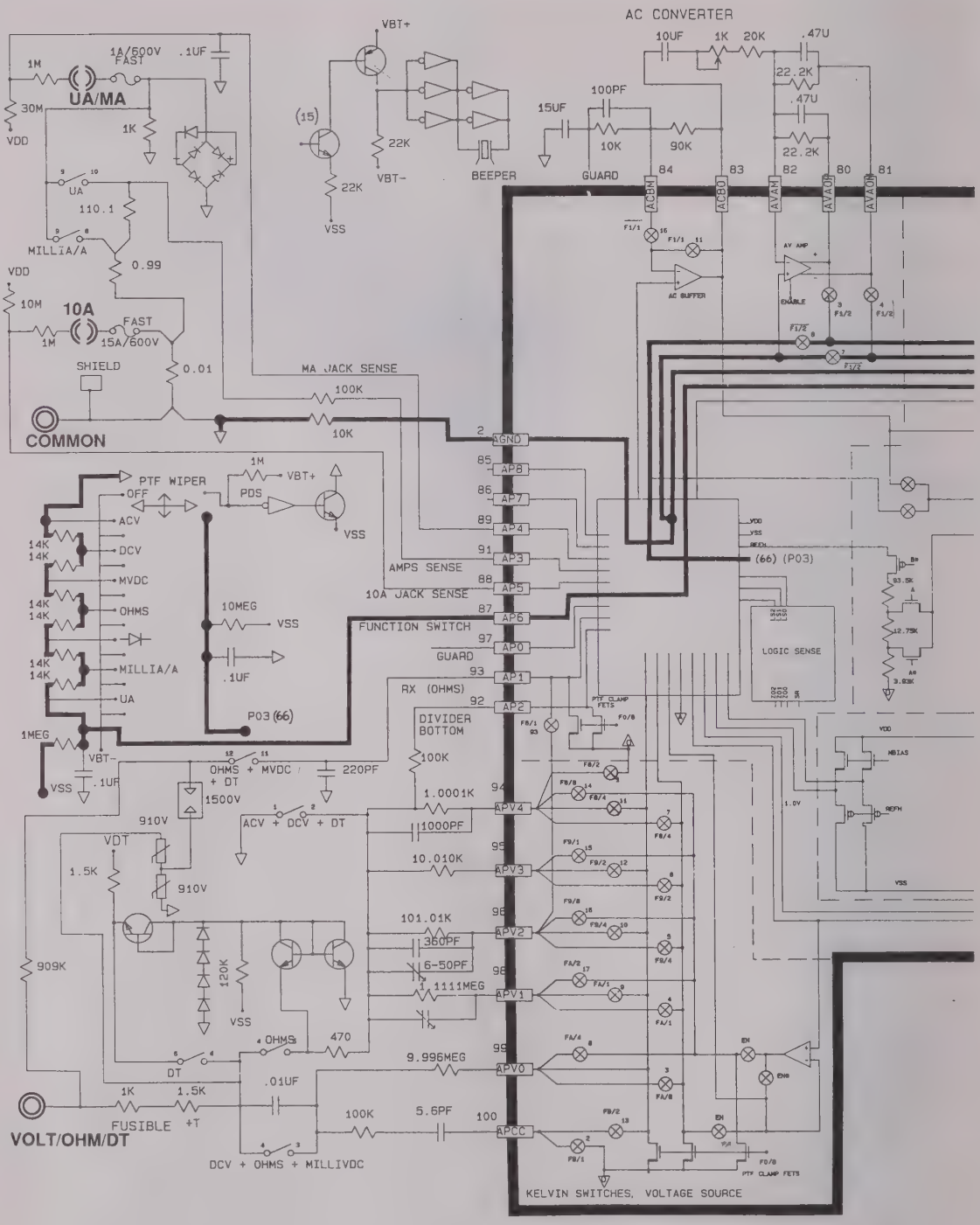
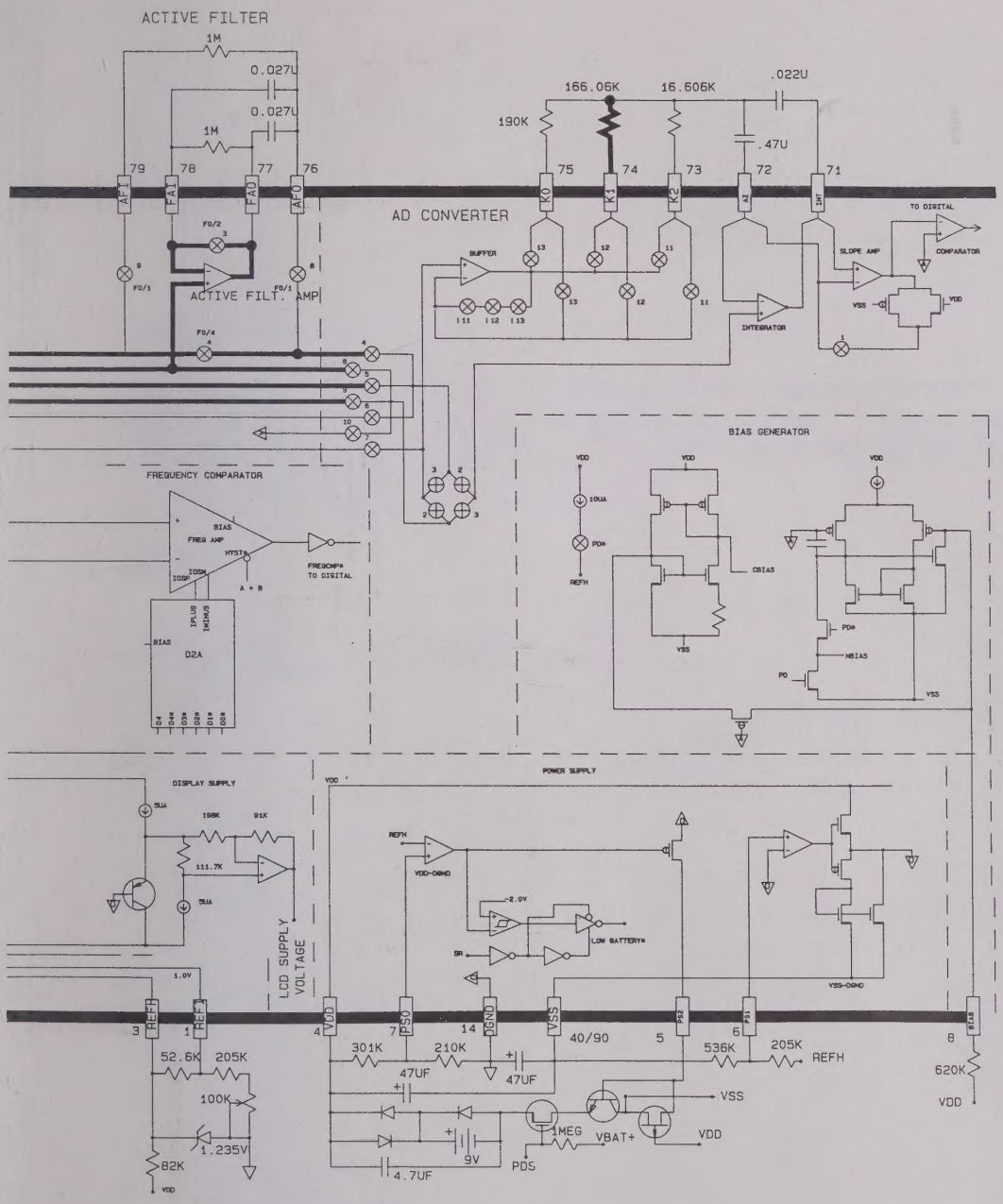


Figure 5-13. Function Switch Range Signal Flow


ACTIVE FILTER
1M
0.027U
0.027U
1M
79
78
77
76
AF1
FA1
FA0
AF0
166.06K
16.606K
.022U
190K
.47U
75
74
73
72
71
K0
K1
K2
A2
INT
AD CONVERTER
TO DIGITAL
COMPARATOR
SLOPE AMP
BUFFER
INTEGRATOR
VDD
VSS
FO/2
FO/1
FO/1
FO/4
ACTIVE FILT. AMP
BIAS GENERATOR
FREQUENCY COMPARATOR
FREQ AMP
BIAS
HYSTR
IOSP
IOSM
FREQCMP#
TO DIGITAL
A + B
D2A
IPLUS
IMINUS
10UA
PD#
REFH
CBIAS
NBIAS
PD
DISPLAY SUPPLY
SUA
198K
91K
111.7K
1.0V
LCD SUPPLY VOLTAGE
POWER SUPPLY
VDD-OGND
-2.0V
LOW BATTERY#
SR
VSS-OGND
REFH
REF
VDD
PSO
OGND
VSS
40/90
P32
P31
BIAS
52.6K
205K
100K
1.235V
82K
301K
210K
47UF
47UF
536K
205K
620K
1MEG
VBAT+
9V
4.7UF
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